N00236.001386
ALAMEDA POINT
SSIC NO. 5090.3

ENGINEERING SERVICES FOR VARIOUS ENVIRONMENTAL ENGINEERING PROJECTS AT NAVAL AIR STATION ALAMEDA, CALIFORNIA

Contract No. N62474-94-D-7535

Contract Task Order 0001

Navy Remedial Project Manager: George Kikugawa

Moju Project Manager: Akali Igbene

ENGINEERING EVALUATION/COST ANALYSIS

SITE 16-CANS C-2 AREA
SOIL REMOVAL ACTION

NAVAL AIR STATION, ALAMEDA
ALAMEDA, CALIFORNIA

Prepared by:

Moju Environmental Technologies, Inc.
315 Washington Street, Suite 200
Oakland, CA 94607

May 15, 1997

ENGINEERING EVALUATION/COST ANALYSIS/REMOVAL ACTION WORKPLAN
in support of a NON-TIME CRITICAL SOIL REMOVAL ACTION
SITE 16
NAVAL AIR STATION, ALAMEDA

APPROVED:

MOJU ENVIRONMENTAL TECHNOLOGIES, INC.	ENGINEERING ACTIVITIES WEST, NAVAL FACILITIES ENGINEERING COMMAND
______________________	______________________
Akali Igbene	George Kikugawa

EXECUTIVE SUMMARY

This Engineering Evaluation/Cost Analysis (EE/CA) identifies proposed soil removal action alternatives for the remediation of PCBs and heavy metal (lead) contaminated soil associated with the storage area of Site 16-CANS Area (Site 16) at Naval Air Station, Alameda, California.

This EE/CA was performed in accordance with current U.S. Environmental Protection Agency (EPA) and U.S. Navy guidance documents for a non-time-critical removal action under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). This EE/CA summarizes the results of the EE/CA process, characterizes the site, identifies removal action objectives, describes removal action alternatives, contains analyses of these alternatives, and describes the recommended removal action alternative.

Site 16 at the Naval Air Station Alameda (NAS), previously referred to as Site 6 and also known as the CANS C-2 Area, has been used as a storage yard where large shipping containers (CANS) were used as storage containers. The soils beneath Site 16 have been contaminated by solvents, paints, paint strippers, and organic chemicals, as well as by the deliberate spraying of PCBs and waste oils for weed control. These chemical spills, which can be visually identified, represent a potential threat to the health of the workers in the area. As such, further investigation and removal of the extent of contamination is warranted under the Navy Assessment and Control of Installation Pollutants (NACIP) Department of the Naval Energy and Environmental Support Activity (NEESA) program.

CERCLA and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (40 CFR Part 300) define removal actions as the cleanup or removal of released hazardous substances, actions undertaken to mitigate or prevent damage to public health or welfare or the environment. The NCP includes provisions for the "removal of drums, barrels, tanks, or other bulk containers that contain or may contain hazardous substances or pollutants or contaminants where it will reduce the likelihood of spillage; leakage; exposure to humans, animals, or the food chain . . . ."

SOURCE, NATURE, AND EXTENT OF CONTAMINATION

Contaminants: Analysis of soil and groundwater samples have been conducted as part of previous site characterization investigations. The analytical results obtained as part of these site characterization activities indicate that soils at Site 16 have been impacted by polychlorinated biphenols(PCBs) and a certain heavy metal (lead). Previous site usage information indicates that PCB-contaminated oil was applied as a weed killer. The potential contaminants, including range of concentration detected and frequency of detection, are summarized in the EE/CA/RAW.

Location of Contaminants: Based on the review of previous investigations, the surface soil in three areas is contaminated with PCBs and the surface soil in four areas is contaminated with lead. These areas are delineated using the 1 ppm action level for PCBs and 300 ppm action level for lead. The approximate lateral extent of the PCB contaminated soils, the extent of lead impacted soils, and the proposed excavation limits are delineated in the EE/CA/RAW.

<u>Soil Contamination Above Removal Action Levels:</u> The estimated volumes of surface soil contaminated with PCBs and Lead above the removal action levels is 1825 cubic yards.

The purpose of the EE/CA is to identify and analyze alternative removal actions to address the removal of the identified contaminants of concern, PCBs and lead, in the shallow soil found in limited "hot spot" areas of the site. For the removal action at Site 16, four alternatives were identified and considered. The candidate alternatives considered include:

- Alternative 1 - No Action
- Alternative 2 - On-Site Treatment with Solvent Extraction and Acid Washing
- Alternative 3 - Off-Site Disposal at a Class I and II Landfill
- Alternative 4 - Onsite Disposal At NAS Site 2 (West Beach Landfill)

Alternative 3 (Off-site Disposal) is the preferred remedial alternative for completing the removal action at Site 16. This alternative uses demonstrated technologies, is readily implementable, meets the NCP criteria of overall protection and mitigation of the risk to human health and the environment, reduces the potential impacts of soil contaminants on the groundwater, is cost effective, and meets statutory requirements. Site 16 could be available for future development review in less than a month after excavation and removal of soil from Site 16.

This Addendum was prepared and performed in accordance with current U.S. Environmental Protection Agency (EPA) and U.S. Navy guidance documents for a non-time critical removal action under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) and in accordance with State of California requirements for a Removal Action Workplan (RAW).

TABLE OF CONTENTS

TABLE OF CONTENTS
(continued)

TABLE OF CONTENTS
(continued)

LIST OF APPENDICES

TABLE OF CONTENTS
(continued)

LIST OF TABLES

TABLE OF CONTENTS
(continued)

LIST OF FIGURES

1.0 INTRODUCTION

This Engineering Evaluation/Cost Analysis (EE/CA) identifies proposed removal action alternatives for the remediation of PCB and lead-contaminated soil associated with the storage area of Site 16 at Naval Air Station, Alameda, California.

Moju Environmental Technologies (Moju) was selected by the Engineering Field Activity West (EFA West), Naval Facilities Engineering Command, U.S. Navy as the prime contractor for reviewing laboratory data prepared by previous Navy contractors and for drafting an Engineering Evaluation and Cost Analysis Removal Action Workplan (EE/CA), based on that data, as part of the non-time-critical soil removal action for the Site 16-CANS C-2 Area at the Naval Air Station Alameda (NAS Alameda). This EE/CA was conducted by Moju.

1.1 REMOVAL ACTION PROGRAM REQUIREMENTS

The National Oil and Hazardous Substance Pollution Contingency Plan (NCP) defines the program requirements for federally-funded removal actions being conducted under CERCLA. The removal action program requirements under the NCP are identified in the Code of Federal Regulations, Title 40, Part 300.415 (40 CFR 300.415). In addition, 40 CFR 300.820 defines the requirements for initiating and maintaining the administrative record file for a removal action performed pursuant to the NCP. The need to perform a removal action at this site and the removal action's definition as a non-time-critical removal action were identified in an EE/CA Approval memorandum dated June 15, 1995. Pursuant to CAL H&SC Section 25356.1, this document will also address the requirements for a Removal Action Workplan (RAW).

As indicated under 40 CFR 300.415(b)(4), when the planning period for the removal action is at least 6 months before on-site removal activities are initiated, the removal action is considered non-time-critical. The public participation procedures to be followed for a removal action are defined in 40 CFR 300.415(m) and 40 CFR 300.820(a).

This EE/CA addresses the implementability, effectiveness and cost of a non-time critical removal action to be conducted at Site 16. The EE/CA/RAW also addresses applicable federal and state requirements and will be used as the basis for a future CERCLA removal action. The Department of the Navy (DON) is the lead agency for the non-time-critical removal action to be conducted at Site 16. As the lead agency, the DON has final approval authority of the recommended alternative selected and of overall public participation. The DON is working in cooperation with the USEPA and CAL EPA (Department of Toxic Substances Control and the California Regional Water Quality Control Board) in implementing this removal action.

This EE/CA is being issued in accordance with public participation requirements identified in the NCP, Cal H&SC Section 25356.1(e) and the public participation plan prepared by NAS Alameda to facilitate public involvement in the decision making process. The public is encouraged to review and comment on the proposed removal activities described in this EE/CA/RAW. Additional information referenced in this document is included in the administrative record for this activity which is available for public review at the following locations:

Alameda Free Library
2264 Santa Clara Ave.
Alameda, CA 94501
(510) 748-4661

Environmental Library
250 Mall Square
Building 1
NAS Alameda,CA 94501-5000
(510) 263-3724

1.2 PURPOSE AND OBJECTIVES

The purpose of this document is to identify, develop, and evaluate removal action alternatives and to assess potential environmental impacts of the selected alternative. The EE/CA incorporates a comparative analytical process to evaluate various candidate removal action technologies. As part of the California Environmental Quality Act (CEQA) process, an assessment of potential environmental impacts of the selected alternative will be evaluated.

The overall objectives of an EE/CA/RAW are to:

- Demonstrate that the non-time-critical removal action requirements under the National Oil and Hazardous Substance Pollution Contingency Plan (NCP) are met.
- Document the procedure and methods used to evaluate and select removal action technologies.
- Provide detailed information on candidate contaminated soil removal action technologies including effectiveness, implementability, and cost.
- Provide documentation to be included in the administrative record of the decision-making process (which involves public participation), used to identify, evaluate, and select the removal action to be performed.
- Provide a conceptual design for the selected soil removal technology.
- Provide data that can be used to evaluate potential environmental impacts of the identified contaminated soil removal technology and identify methods to mitigate those impacts.

1.3 REPORT ORGANIZATION

This EE/CA addresses the implementability, effectiveness, and the cost of remediation of an estimated 1,825 cubic yards of shallow soil contaminated with polychlorinated biphenyls (PCBs) and lead. It also addresses applicable regulatory requirements.

This document is organized into seven sections. Section numbers and main headings are:

- 1.0 Introduction
- 2.0 Site Characterization
- 3.0 Identification of Soil Removal Action Objectives
- 4.0 Identification and Screening of General Removal Actions and Technologies
- 5.0 Comparative Analysis of Removal Action Alternatives
- 6.0 Recommended Removal Action Alternative
- 7.0 References

Section 2.0 presents a description of site 16, the historic land use, current land use, and a description of Site 16. Section 2.0 also gives a brief summary of the site geology and hydrogeology and the extent of soils contaminated with PCBs and lead. For purposes of this evaluation, soils containing PCBs in concentrations above 1 ppm and/or lead above 300 ppm are subject to a removal action. Section 3.0 summarizes the key objectives of the removal action and Applicable or Relevant and Appropriate Requirements (ARARs). Section 4.0 identifies and screens potential removal action technologies and alternatives. Section 5.0 compares the various removal action alternatives. The preferred alternative is presented in a conceptual process design in Section 6.0. Section 7.0 lists references cited in preparation of this document.

Additional information can be found in Appendix A: Compilation of Historical Data;
Appendix B: ARARs Data; and Appendix C: Screening of General Removal Action.

2.0 SITE CHARACTERIZATION

The information for this site characterization was taken from various sources, including:

- Initial assessment study of NAS Alameda by Ecology and Environment, Inc., 1983
- Site characterization by Wahler Associates, 1985
- Site investigations by Canonie Environmental Services Corp., 1990
- Additional investigations by PRC and Montgomery Watson, 1994

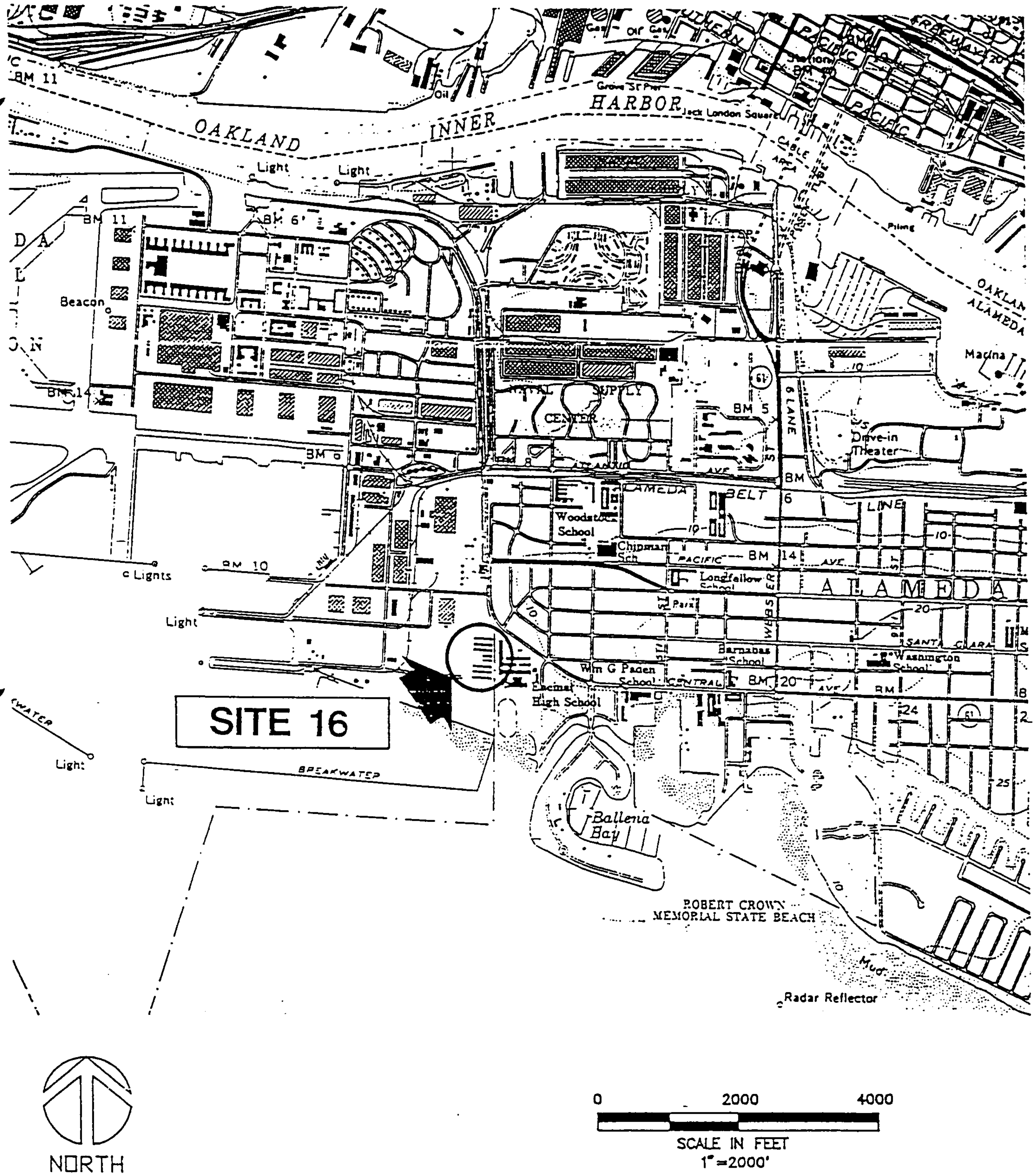
2.1 SITE DESCRIPTION AND BACKGROUND

2.1.1 Site Location

The NAS Alameda is located at the western end of Alameda Island in Alameda County, California. NAS Alameda is bounded on the north by the Oakland Inner Harbor, on the west and south by San Francisco Bay, and on the east by the City of Alameda. Site 16 is located at the southeast corner of NAS Alameda between Avenues M and N and east of 11th Street. The site includes the CANS C-2 Area, which was part of the Initial Assessment Study Site 6. Site 16 is shown in relation to the NAS Alameda complex on the Vicinity Map, Figure 2-1.

2.1.2 Structures/Topography

The NAS Alameda complex occupies about 2,635 acres, of which about 1,525 acres are usable land and about 1,110 acres are shoreline and marine waters. Site 16 occupies about 6.5 acres, of which about 3 acres are open space used as a storage yard, with the remaining 3.5 acres containing large steel shipping containers (CANS) that have been converted for storage. The CANS are structurally connected to concrete foundations and are not readily movable. The area around the CANS is paved with asphalt concrete. Surface drainage is collected by drop inlets located within the paved areas. The storage yard area is primarily unpaved; however, the ground surface is covered with temporary runway plates made of perforated steel. Key features of Site 16 are shown on the Site Plan, Figure 2-2.



SOURCE: USGS 7 1/2 MINUTE TOPOGRAPHIC QUADRANGLE,
OAKLAND WEST, CALIFORNIA,
PHOTOREVISED 1980 AT SCALE 1:24,000

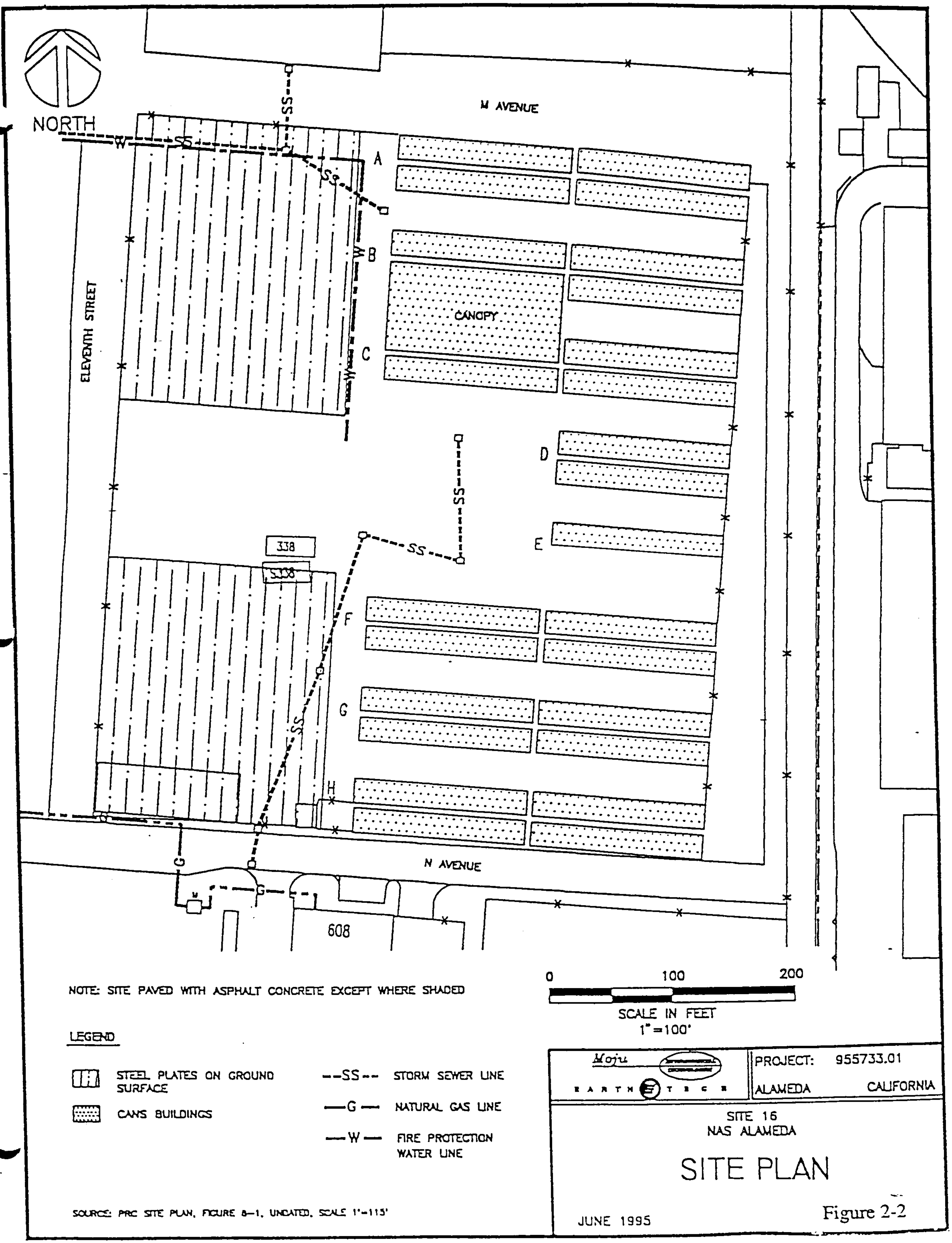
Moju / EARTH TECH	PROJECT: 955733.01
	ALAMEDA CALIFORNIA

SITE 16
NAS ALAMEDA

VICINITY MAP

MAY 1995

Figure 2-1



NORTH
M AVENUE
N AVENUE
ELEVENTH STREET
A
B
C
D
E
F
G
H
CANOPY
338
S338
608
SS
W
G
0
100
200
SCALE IN FEET
1" = 100'
NOTE: SITE PAVED WITH ASPHALT CONCRETE EXCEPT WHERE SHADED
LEGEND
STEEL PLATES ON GROUND SURFACE
CANS BUILDINGS
--SS-- STORM SEWER LINE
—G— NATURAL GAS LINE
—W— FIRE PROTECTION WATER LINE
SOURCE: PRC SITE PLAN, FIGURE 8-1, UNDATED, SCALE 1"=115'
EARTH TECH
PROJECT: 955733.01
ALAMEDA CALIFORNIA
SITE 16
NAS ALAMEDA
SITE PLAN
JUNE 1995

Figure 2-2

2.1.3 Type of Facility and Operational Status

The Site 16 area has been used for over 50 years as a storage area over the course of different operational missions. The estimated 1,825 cubic yards of contaminated soil at Site 16 are mostly associated with surface soil in storage yard area where equipment were stored and probably from application of PCB contaminated oil as a weed killer. Waste oils (some containing PCBs) were reported to have been used for weed control in the storage yard area until 1963. The storage yard was reportedly used to store aircraft parts, warehouse equipment, paints, solvents, acidic and alkaline liquids in storage containers and drums [Canonie, 1990]. Some of the storage containers and drums became corroded, resulting in leaks. Electrical transformers containing (PCBs) were also stored in the yard. During the initial assessment study [E&E, 1983], a PCB transformer located in the northwest corner of the storage yard was reported to have leaked. The spill contamination was reportedly removed in August 1982 by IT Corporation. From 1983 onward, various investigations have occurred to evaluate the extent of residual contamination at the site.

Since 1982, the storage yard has been used to store various obsolete equipment and miscellaneous parts such as paint stripping baths, electrical equipment, and aircraft parts. The CANS area has been used for equipment storage. The CANS C-2 area (selected C-2 portions) are currently being used for various tenant activities, including offices. The storage yard is currently clear and is not being utilized. The main storage yard is mostly unpaved, though much of it has been "surfaced" with base rock and/or perforated steel temporary runway plates. The yard is bisected by an east/west-running driveway paved with asphalt concrete and has similar paved drives running north/south along both sides (see Figure 2-2).

2.1.4 Geology and Soil Information

For the most part, NAS Alameda is built on land created by placing fill (mostly dredge fill) over marginal lands at the perimeter of Alameda Island. Alameda Island was formed by a natural process of beach formation and deposits. This type of deposit, identified by geologists as the "Merritt Sand Formation," is classified as a fine-grained, well-sorted sand interspersed with layers of clayey sand and clay. In contrast, the former tidal flats of the estuary and the bay bottom surrounding Alameda are made up of more recent geological deposits of very fine clay and silt particles held in suspension in bay water and gently deposited. These soils, known as "bay mud," and are plastic, highly compressible, and have low strength. Additional land beyond the original Alameda Island was obtained by filling in tidal areas of the bay. The fill came from many places, including material dredged from the estuary during construction of the Posey Tube in the 1920s. Most of the station area is overlaid with silty sand and sand fill 6 to 8 feet thick which ranges from moderately to poorly compacted. Beneath the fill, soft silt clay (bay mud) extends to depths of 25 to 120 feet below the existing ground surface. The soil below the bay mud consists of loose to dense sands, both silty and clean, and stiff to very stiff sandy clays. The fill soils range from low to moderate in compressibility, while the underlying bay mud is high in compressibility. Groundwater has been encountered between 4.5 and 6.5 feet below ground surface. Groundwater is reported to flow to the southwest with an estimated gradient of 0.002 foot/foot.

2.1.5 Surrounding Land Use and Populations

Land use in the vicinity of NAS Alameda is primarily residential and military. The base is bordered on the north by Oakland Inner Harbor, north of which is the main site of the Naval Supply Center-Oakland (NSCO), occupying 541 acres in Alameda County. To the west and south of the station is the San Francisco Bay. To the east is a mixture of industrial, residential, and public land uses (Figure 2-3). The Naval Supply Center Oakland-Alameda Facility (NSCO-AF) occupies 107 acres immediately to the east of the Todd Shipyards. The Naval Supply Center Oakland-Alameda Annex (NSCO-AA) occupies 81 acres and is located to the east of NAS Alameda and the southern boundary of NSCO-AF. The College of Alameda Peralta Junior College District lies on the boundary of NSCO-AF. The remaining land use to the east of NAS Alameda is residential, with scattered commercial establishments such as restaurants and retail stores. Schools located in this residential area include Woodstock School, Chipman School, Longfellow School, William G. Paden School, and Encinal High School, which abuts the southeastern edge of the station. Located to the east of Encinal High School is the Robert Crown Memorial State Beach. The state-protected marine reserve, Crab Cove, is located at the west end of this beach.

Since NAS Alameda is on an island, all potential surface water and groundwater migration pathways lead to essentially one place, the ocean, by way of the San Francisco Bay and the Oakland Inner Harbor channel. The average groundwater flow into the bay is on the order of 15 gallons per day per foot of shoreline. Contaminants in the groundwater could be expected to reach the bay waters at the same rate or less, depending on the attenuation capabilities of the soil. Surface waters on the base reach the bay waters by way of the storm water runoff systems or sheet runoff and small rivulet channels. Any contaminants dumped into these systems will eventually reach the bay.

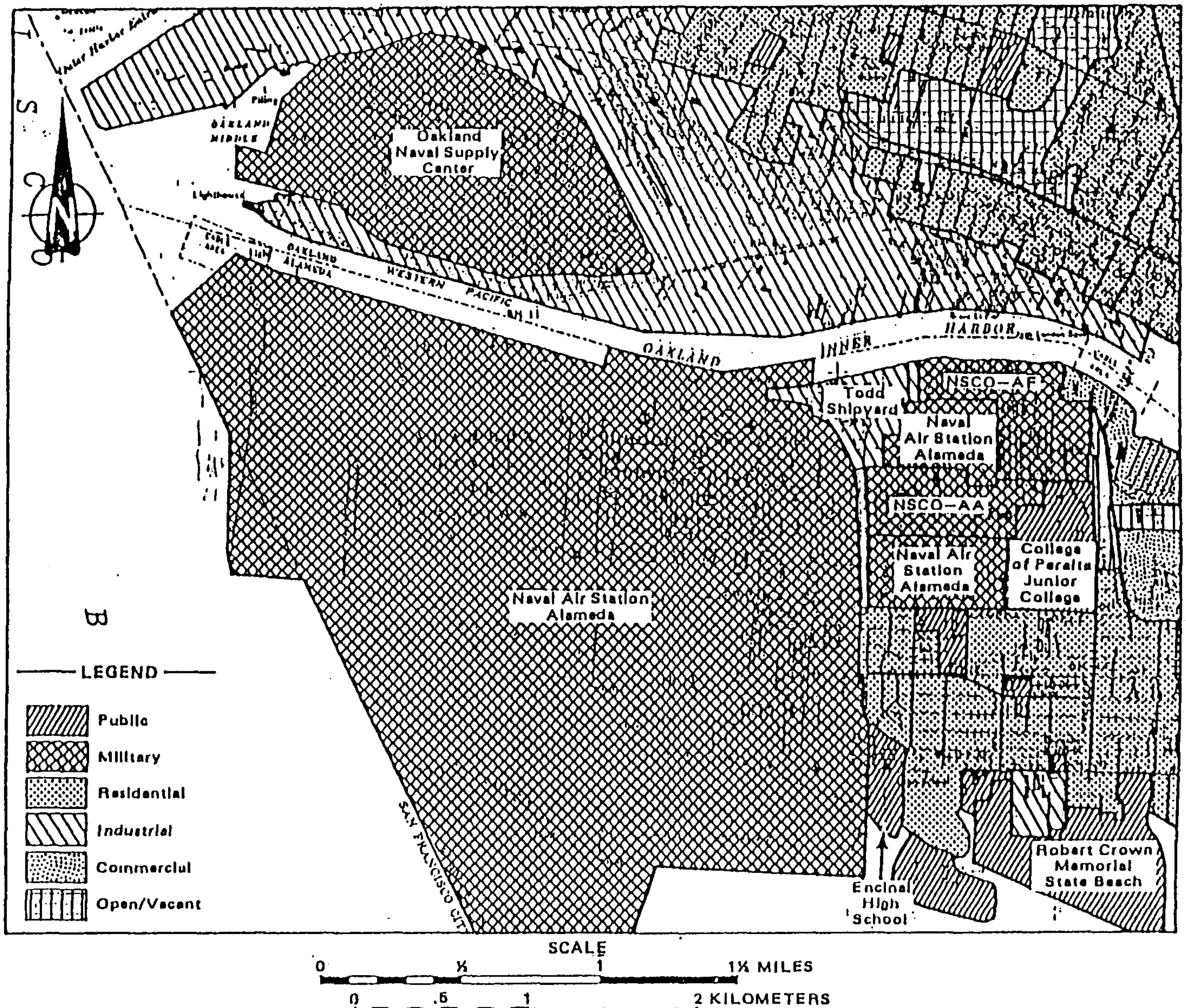


Figure 2-3 ADJACENT LAND USE, NAS ALAMEDA

NAS Alameda is closed as an active military base and the facility is transitioning to civilian reuse. Currently some of the existing facilities are occupied by primarily light industrial tenants primarily light industrial.

NAS Alameda receives its water from the East Bay Municipal Utility District (EBMUD). Shallow ground water has never been considered as a water supply.

No considerations related to the National Historic Preservation Act have been identified.

2.1.6 Sensitive Ecosystems

There are no sensitive ecosystems at Site 16 itself, whichis partially paved and stripped of vegetation. However, because Site 16 is located close to the San Francisco Bay and the storm drains on site carry runoff into the bay, potential sensitive receptors are Bay aquatic life.

The largest nesting and breeding grounds in Northern California for the California least tern are located on NAS Alameda. In addition to the sensitive environment of the least tern's nesting grounds, NAS Alameda is near several other sensitive environments located in the San Francisco Bay Area. Southeast of NAS Alameda in the bay is commercial fishing for herring and sports fishing for leopard sharks. There is also a public beach located southeast of NAS Alameda. Nearby, another endangered bird species, the California clapper rail, is found. NAS Alameda is also near a flatfish nesting area. Crab Cove, located at the west end of the Robert Crown Memorial State Beach, is a unique marine reserve protected by California law and administer by the East Bay Regional Park District.

2.1.7 Meteorology

The prevailing winds of the San Francisco Bay area are from a westerly direction. Records show that winds of gale force or greater have occurred only rarely in the area. Heavy fogs occur on the average of 21 days per year. These fogs impair visibility for navigation at Oakland an average of fewer than 100 hours per year. Freezing temperatures rarely occur, and no snow or icy conditions are encountered. Rainfall averages approximately 20 inches annually, generally from October to May.

2.2 HISTORY OF PREVIOUS REMEDIAL ACTIONS, INVESTIGATION AND ACTIVITIES

2.2.1 Previous Removal Actions

It has been reported by base environmental personnel that 10 cubic yards of the PCB-contaminated soil from a transformer spill were removed in August 1982 by IT Corporation under contract to NARF. Tests indicate that the soil remaining on the spill site contains less than 1 ppm PCBs. Subsequent investigations from 1983 through 1994 found additional areas of PCBs above 1 ppm as well as lead concentrations of potential concern. However, no further removal actions have been recorded.

2.2.2 Previous Investigations

Following the limited removal action by IT in 1982, four investigations at the site have occurred between 1983 and 1994.

1983: Ecology and Environment performed an initial assessment study (IAS) of Site 16 (then identified as Site 6). The purpose of an IAS is to identify and assess sites posing a potential threat to human health or the environment due to contamination from past hazardous materials operations. Each of the sites was evaluated with regard to contamination characteristics, migration pathways, and pollutant receptors. No sampling or analysis was performed as part of this IAS. The IAS concluded that "chemicals have leaked into the ground and PCBs were used as weed killers."

1985: Wahler Associates (Wahler) conducted an initial round of surface soil and groundwater sampling in response to the recommendations of the IAS. They collected 10 surface soil samples at depths of approximately 6 inches bgs; one groundwater sample and one soil sample from 6 feet bgs. The samples were analyzed for organochlorine pesticides and PCBs (by EPA Method 608), two chlorophenoxyl herbicides, 17 metals, and gasoline hydrocarbons. With one exception (0.05 ppm gasoline hydrocarbons), no organics were detected in the soil samples. Soil detection limits were 0.5 ppm for PCBs, and 0.002 ppm for the majority of the chlorinated pesticides (methoxychlor and Toxaphene had detection limits of 0.5 and 2.0 ppm, respectively). The two chlorinated herbicides, 2,4-D, and 2,4,5-trichlorophenoxypropionic acid (2,4,5-TP), had soil detection limits of 0.001 ppm. In groundwater, 0.002 mg/L of 2,4-dichlorophenoxyacetic acid (2,4-D) was reported.

1990: Canonie Environmental Services performed an initial remedial investigation at Site 16 to evaluate whether the soil and groundwater had been impacted by chemicals of concern. Canonie conducted surface soil sampling and drilled nine soil borings, then converted three of these boreholes to monitoring wells within the storage yard of the CANS C-2 Area. Canonie collected 55 surface soil samples and 99 subsurface soil samples at depths of 0.5 to 15.0 feet bgs. The water table was reported to be between 4.5 and 6.5 feet bgs. All surface soil and subsurface soil samples were collected at the western half of the site. VOCs, SVOCs, metals, pesticides and PCBs, and herbicides were detected in the soils at Site 16.

The surface samples were not analyzed for VOCs. However, VOCs were detected in subsurface samples at trace levels over a range of depths from all nine borings. No distinct distribution patterns are observed from VOC detected data. No soil samples contained total VOC levels above 1 ppm.

SVOCs (primarily PAH compounds) were detected at a majority of the surface soil samples throughout Site 16. However, subsurface samples from only two of the borings were found to contain SVOCs. Four surface soil samples contained a total SVOC concentration above 10 ppm.

For the 55 surface samples collected, there were 344 occurrences of 18 metals (antimony, cadmium, copper, lead, magnesium, molybdenum, selenium, silver, zinc, arsenic, barium, calcium, chromium, cobalt, iron, manganese, nickel, and potassium) that were above the 95 percent/95 percent statistical tolerance limit for background concentrations in soil at NAS Alameda (PRC/JMM, 1992). However, for the same group of samples, there were only 132 occurrences in 49 samples of nine metals (the first nine listed in the previous sentence) that were above the expected range for native soils (PRC/JMM, 1992).

For the 45 subsurface boring samples analyzed for metals, there were eight occurrences in three samples of six metals (cadmium, cobalt, copper, nickel, potassium, and sodium) that were above the 95 percent/95 percent statistical tolerance interval for background concentrations at NAS Alameda (PRC/JMM, 1992). Five of these eight occurrences were in a single sample from boring MWC2-1. This sample was the only subsurface soil sample indicating a metal (magnesium) whose concentration was above the expected range for native soils (PRC/JMM, 1992).

Pesticides and/or PCBs were detected in 15 surface or near-surface (above 1.5 feet bgs) soil samples distributed throughout Site 16. Three PCBs (Aroclor-1248, Aroclor-1254, and Aroclor-1260) were detected in nine surface samples at concentrations above 1 ppm. Most of the detections are from samples located at the northwest corner of the site.

All 55 surface samples and 46 subsurface boring samples were analyzed for total cyanide. Cyanide was detected in 18 of the surface samples at concentrations ranging from 1.0 ppm to 7.8 ppm.

Various other analyses were performed on soil samples from the borings to determine pH, cation exchange capacity, percent ash, and concentrations of chloride, nitrate, sulfate, Total Kjeldahl Nitrogen (TKN), and total phosphorus.

1994: PRC Environmental and Montgomery Watson have recently conducted an additional investigation to fill data gaps and complete the definition of the extent of pesticide, PCB, and metal distribution at Site 16 on the eastern half of the site. Thirty additional soil samples were collected and analyzed for the chemicals of concern. A compilation of the results of the analysis was provided to Moju Environmental Technologies for data interpretation in May 1995.

PRC and Montgomery Watson collected 30 soil samples, 10 groundwater samples and 3 grab water samples at cone penetrometer test location and storm drain (none point source, NPS) sediment samples at two locations. Samples were analyzed for metals using EPA Method 6010, volatile organic chemicals (VOCs) using EPA Method 8240, semivolatile organic chemicals (SVOCs) using EPA Method 8270, and chlorinated pesticides/PCB using EPA Method 8080. Soil samples were collected at the surface (0 feet), 2.5 feet, and 5.0 feet below ground surface.

No PCBs were detected above 1.0 ppm in soil, although Aroclor 1260 was detected in 5 surface soil samples at less than 0.26 ppm and in storm drain samples at 0.57 ppm.

No SVOCs were detected at significant concentrations. All SVOCs were detected at less than 1.0 ppm, except one soil sample which contained pentachlorophenol at 3.85 ppm. Metals were not detected at concentrations higher than those found in previous Site 16 investigations.

Moju Environmental Technologies has compiled and interpreted all this historical data. A summary is contained in Appendix A.

2.3 SOURCE, NATURE, AND EXTENT OF CONTAMINATION

Contaminants: Analyses of soil and groundwater samples were conducted as part of previous site characterization investigations. The analytical results obtained as part of these site characterization activities indicate that soils at the Site 16 site have been impacted by (PCBs) and the metal (lead). Previous site use information indicates application of PCB contaminated oil as weed killer. The potential contaminants, including range of concentration detected and frequency of detection, are summarized in Table 2-1.

Location of Contaminants: Based on review of the previous investigations, three areas of soil contaminated with PCBs and four areas with lead were delineated using the 1 ppm action level for PCBs and 300 ppm action level for lead. The approximate lateral extent of PCB contaminated soils at Site 16 are shown on Figure 2-4. The extent of the lead impacted soils are shown on Figure 2-5. Proposed excavation limits for PCB and Pb above their action levels are delineated on Figure 2-6.

Soil Contamination Above Removal Action Levels: Based on review of the previous investigations, three areas of soil contaminated with PCBs and four areas with lead were delineated using the 1 ppm removal action level for PCBs and 300 ppm removal action level for lead. The estimated volumes and locations of soil contaminated with PCBs above 1 ppm and lead above 300 ppm are summarized in Table 2-2.

Table 2-1 POTENTIAL CHEMICALS OF CONCERN

Results for VOCs Detected in Soil Samples
- SITE 16

SAMPLE ID	Sample Depth (ft)	Chemical	# Of Hits	Highest Conc. (ppm)	PRG (ppm)	# of Hits > PRG	Comment
MWC2-2	6.0	Methylene Chloride	38/61	0.023	11	0/61	Lab Contaminant GW - 1 ppb
BC2-7	14.0	Acetone	31/61	0.110	2000	0/61	Lab Contaminant
BC2-4	6.0	Carbon Disulfide	6/61	0.038	16	0/61	Lab Contaminant
BC2-7	7.5	1,1-Dichloroethane	1/61	0.005	840	0/61	
BC2-8	11.5	Cis 1,2-Dichloroethene	3/61	0.017	59	0/61	
BC2-4	14.5	2-Butanone (MEK)	7/61	0.007	8700	0/61	Lab Contaminant
BC2-6	4.0	Toluene	32/61	0.200	1900	0/61	
BC2-4	6.0	1,4-Dichlorobenzene	1/61	0.003	7.4	0/61	GW - 0.3 ppm*
BC2-4	6.0	1,2-Dichlorobenzene	2/61	0.011	2300	0/61	GW - 3.7 ppm*

*: May be from off-site.

Results for SVOCs Detected in Soil Samples
- SITE 16

Sample ID.	Sample Depth (ft)	Chemical	# Of Hits	Highest Conc. (ppm)	PRG (ppm)	# of Hits > PRG	Comment
SSC2-23	0.5	2,4-Dimethylphenol	2/134	1.1	1300	0/134	
SSC2-50/52		Naphthalene	6/134	0.13	800	0/134	GW - 0.7 ppb
SSC2-50	0.5	2-Methylnaphthalene	9/134	0.27	N/A	-	GW - 0.9 ppb
BC2-4	14.5	Acenaphpthene	10/134	0.045	360	0/134	
SSC2-49	0.5	Fluorene	5/134	0.12	300	0/134	
BC2-4	14.5	Phenanthrene	15/134	0.57	N/A	-	
BC2-4	14.5	Anthracene	1/134	0.25	19.0	0/134	
SSC2-1	0.5	Di-n-butylphthalate	3/134	3	6500	0/134	
BC2-4	14.4	Fluoranthene	5/134	1.3	2600	0/134	
BC2-4	14.5	Pyrene	9/134	2.2	2000	0/134	
BC2-4	14.5	Benzo(a)anthracene	1/134	0.69	0.61	1/134	
BC2-4	14.5	Chrysene	5/134	0.73	24	0/134	
SSC2-28	**0.5**	**bis-(2-Ethylhexyl)phthalate**	**23/134**	**90**	**32**	**1/134**	Blank = 0.660 ppm GW - 0.6 ppb
BC2-4	14.5	Benzo(b)fluoranthene	3/134	0.82	0.61	1/134	
BC2-4	14.5	Benzo(k)fluoranthene	1/134	0.34	0.61	0/134	
BC2-4	14.5	Benzo(a)pyrene	1/134	0.97	0.61	1/134	
BC2-4	14.5	Indeno(1,2,3-cd)pyrene	2/134	0.56	0.061	0/134	
BC2-4	14.5	Dibenz(a,h)anthracene	1/134	0.096	0.12	0/134	
BC2-4	14.5	Benz0-(g,h,i)perylene	1/134	0.65	N/A	-	
S16-70	0.0	2-Methylphenol	1/134	0.052	3300	0/134	
S16-70	0.0	4-Methylphenol	2/134	0.048	330	0/134	
S16-61	0.0	4-Chloro-3-methylphenol	1/134	0.021	N/A	-	
S16-61	0.0	4-Nitrophenol	1/134	0.024	N/A	-	
S16-61	0.0	Pentachlorophenol	2/134	0.21	2.5	0/134	

Table 2-1 POTENTIAL CHEMICALS OF CONCERN

Results for Pesticides, PCBs and Glyphosate Detected in Soil Samples - SITE 16

Sample ID.	Sample Depth (ft)	Chemical	# Of Hits	Highest Conc. (ppm)	PRG (ppm)	# Of Hits > PRG	Comment
BC2-6R	1.5	alpha BHC	3/135	0.004	0.071	0/135	
BC2-8R	1.5	beta-BHC	1/135	0.003	0.25	0/135	
BC2-6R	1.5	gamma-BHC (Lindane)	1/135	0.004	0.34	0/135	
BC2-8R	1.5	4,4'-DDD	5/135	0.011	1.9	0/135	
SSC2-38	0.5	4,4'-DDE	5/135	0.049	1.3	0/135	
SSC2-38	0.5	4,4'-DDT	6/135	0.18	1.3	0/135	
SSC2-24	0.5	Aroclor-1248 (PCB)	1/135	4.600	0.066/0.34**	61/135	Chemicals
SSC2-23	0.5	Aroclor-1254 (PCB)	2/135	23.000	1.4/19	16/135	of
SSC2-31	0.5	Aroclor-1260 (PCB)	13/135	7.300	0.066/0.34**	62/135	Concern
SSC2-35	0.5	Glyphosate	2/67	1	6500	0/135	

*: Values for Total DDT
**: Values for Total PCBs, Residential/Commerical
***: Values for Total PCBs

Results for Metals Detected in Soil Samples - SITE 16

Sample ID.	Sample Depth (ft)	Chemical	# Of Hits	Highest Conc. (ppm)	PRG (ppm)	# of Hits > PRG	Comment
SSC2-50	0.5	Aluminum	134/134	17300	77000	0/134	
SSC2-28	0.5	Antimony	21/134	31	31	0/134	
SSC2-6	0.5	Arsenic	21/134	45	22	1/134	GW - 0.021 ppm + Background <100ppm in CA
SSC2-54	0.5	Barium	118/134	316	5300	0/134	
SSC2-50	0.5	Beryllium	22/134	0.70	0.14	22/134	Background = 0.87 ppm (PRC 1993, Study)
SSC2-15	0.5	Cadmium	49/134	34	38/9(Cal)	0/134	* Background <22 ppm in CA
SSC2-50	0.5	Calcium	134/134	19900	N/A	-	
SSC2-14	0.5	Chromium	134/134	554	210	3/134	+ Background <2000 ppm in CA
SSC2-47/55	0.5	Cobalt	69/134	15	N/A	-	
SSC2-7	0.5	Copper	112/134	1390	2800	0/134	
SSC2-14	0.5	Iron	134/134	117000	N/A	-	
SSC2-39	0.5	Lead	91/134	500	400/130**	38/134	GW - 1.5 ppb EPA AL 15 ppb MWC2-1-Q1
SSC2-50	0.5	Magnesium	134/134	9770	N/A	-	
SSC2-45	0.5	Manganese	134/134	573	380	19/134	Essential Element
SSC2-15	0.5	Molybdenum	23/134	21	380	0/134	
SSC2-7	0.5	Nickel	134/134	798	1500/150(Cal)	2/134	+ Background <700 ppm in CA
MWC2-1	11.5	Potassium	103/134	2700	N/A	-	
SSC2-14	0.5	Silver	25/134	74	380	0/134	
SSC2-23	0.5	Sodium	19/134	8	N/A	-	
SSC2-15	0.5	Thallium	1/134	50	6.1	1/134	
SSC2-50	0.5	Titanium	22/134	1780	47000	0/134	
MWC2-1	11.5	Vanadium	134/134	49	540	0/134	
SSC2-8	0.5	Zinc	132/134	1020	23000	0/134	

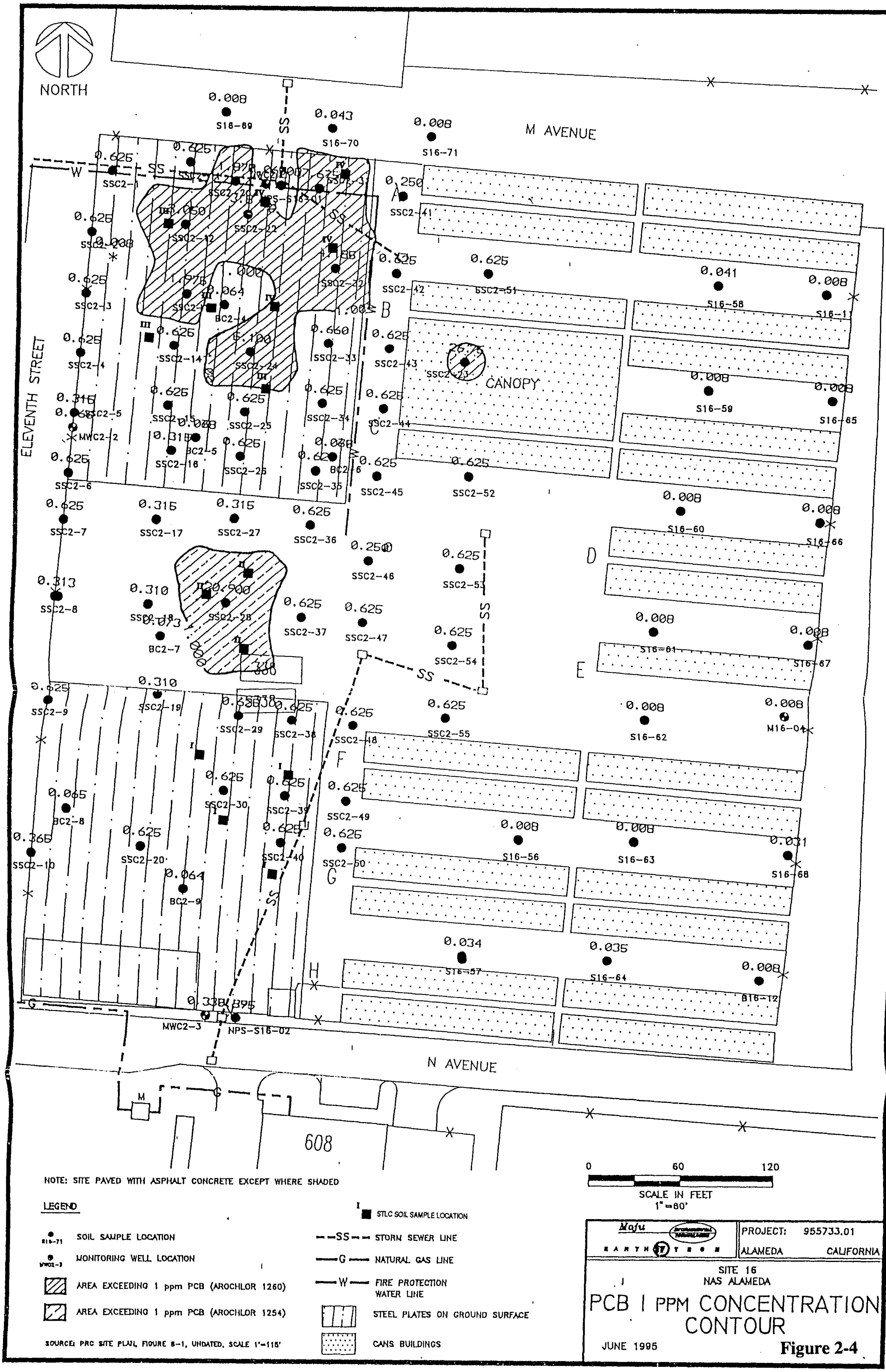
+: Shacklettle & Boernger 1984
*: Mortvedt 1987
**: 400/130, Residential: EPA/Cal State

Date: 07/10/95

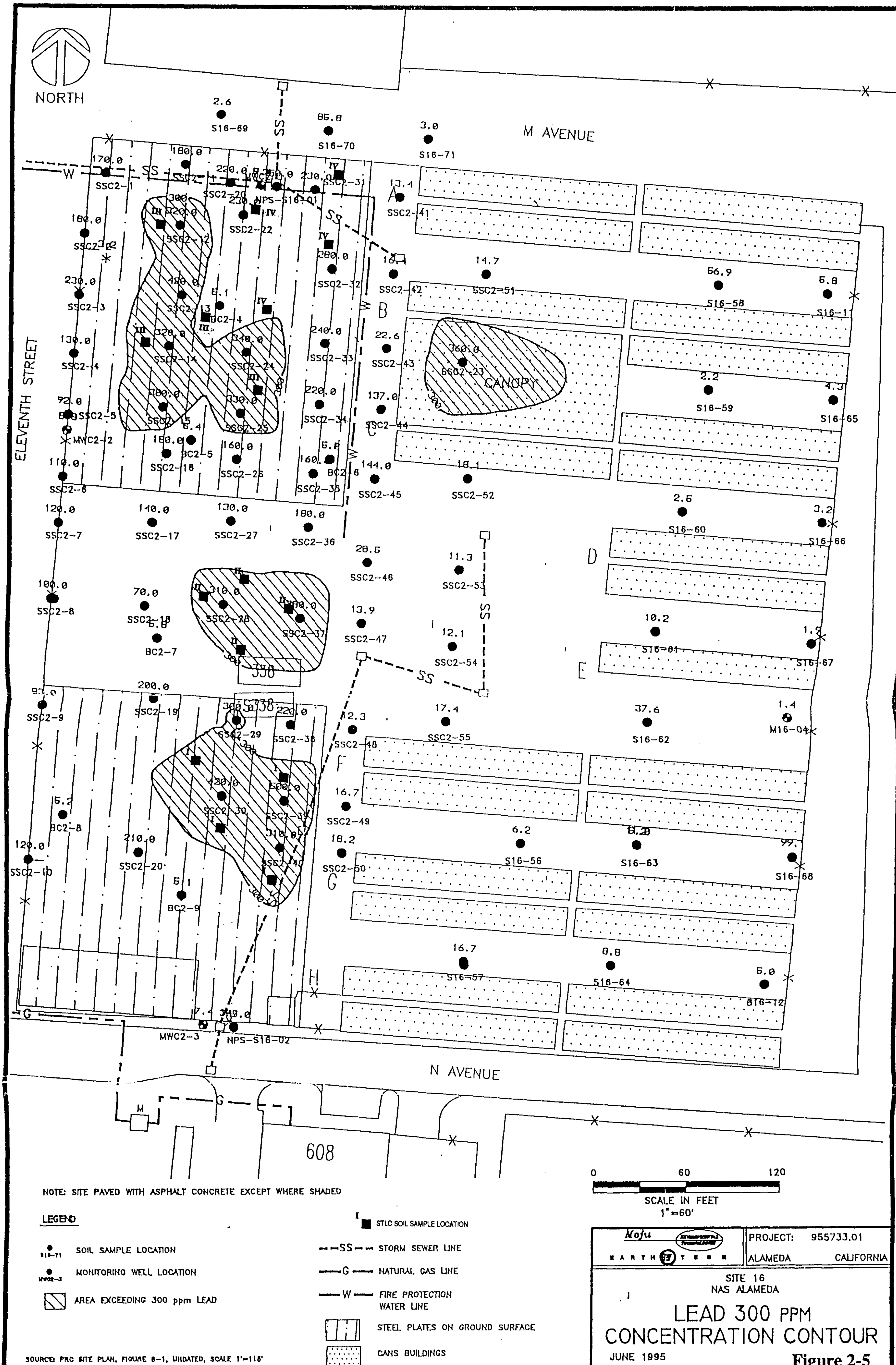
Table 2-2 PCB- and Lead- Contaminated Soil Volume Estimates

Table 2-2 PCB- and Lead-Contaminated Soil Volume Estimates

Contamination Location	Estimated Soil Volume (cubic yards)
PCB/LEAD-SCA-1	950
PCB/LEAD-SCA-2	225
PCB/LEAD-SCA-3	300
PCB/LEAD-SCA-4	350
Total Estimated Volume of PCB/Lead Contaminated Soil	1825



NORTH
M AVENUE
N AVENUE
ELEVENTH STREET
CANOPY
608
SS
W
G
NOTE: SITE PAVED WITH ASPHALT CONCRETE EXCEPT WHERE SHADED
LEGEND
SOIL SAMPLE LOCATION
MONITORING WELL LOCATION
AREA EXCEEDING 1 ppm PCB (AROCHLOR 1260)
AREA EXCEEDING 1 ppm PCB (AROCHLOR 1254)
SOURCE: PRC SITE PLAN, FIGURE 6-1, UNDATED, SCALE 1"=115'
STLC SOIL SAMPLE LOCATION
STORM SEWER LINE
NATURAL GAS LINE
FIRE PROTECTION WATER LINE
STEEL PLATES ON GROUND SURFACE
CANS BUILDINGS
0 60 120
SCALE IN FEET
1"=60'
PROJECT: 955733.01
ALAMEDA CALIFORNIA
SITE 16
NAS ALAMEDA
PCB 1 PPM CONCENTRATION CONTOUR
JUNE 1995
Figure 2-4


NORTH
M AVENUE
N AVENUE
ELEVENTH STREET
CANOPY
608
A
B
C
D
E
F
G
H
338
NOTE: SITE PAVED WITH ASPHALT CONCRETE EXCEPT WHERE SHADED
LEGEND
SOIL SAMPLE LOCATION
MONITORING WELL LOCATION
AREA EXCEEDING 300 ppm LEAD
STLC SOIL SAMPLE LOCATION
STORM SEWER LINE
NATURAL GAS LINE
FIRE PROTECTION WATER LINE
STEEL PLATES ON GROUND SURFACE
CANS BUILDINGS
SOURCE: PRC SITE PLAN, FIGURE 6-1, UNDATED, SCALE 1"=116'
0 60 120
SCALE IN FEET
1"=60'
PROJECT: 955733.01
ALAMEDA CALIFORNIA
SITE 16
NAS ALAMEDA
LEAD 300 PPM
CONCENTRATION CONTOUR
JUNE 1995
Figure 2-5


NORTH
M AVENUE
N AVENUE
ELEVENTH STREET
CANOPY
608
A
B
C
D
E
F
G
H
NOTE: SITE PAVED WITH ASPHALT CONCRETE EXCEPT WHERE SHADED
LEGEND
SOIL SAMPLE LOCATION
MONITORING WELL LOCATION
AREA EXCEEDING 1 ppm PCB
AREA EXCEEDING 300 ppm LEAD
PROPOSED EXCAVATION LIMITS
STLC SOIL SAMPLE LOCATION
CANS BUILDINGS
STORM SEWER LINE
NATURAL GAS LINE
FIRE PROTECTION WATER LINE
STEEL PLATES ON GROUND SURFACE
SOURCE: PRC SITE PLAN, FIGURE 8-1, UNDATED, SCALE 1"=118'
0
60
120
SCALE IN FEET
1"=60'
PROJECT: 955733.01
ALAMEDA CALIFORNIA
SITE 16
NAS ALAMEDA
PROPOSED EXCAVATION LIMITS
JUNE 1995

Figure 2-6

2.4 ANALYTICAL DATA

Chemicals detected in previous soil investigations are listed in Table 2-1, Potential Chemicals of Concern. The chemicals are divided into four analytical groups: volatile organic chemicals (VOC), semivolatile organic chemicals (SVOC), pesticides and PCBs, and metals. No analysis was conducted or reported for oil, paint thinner, or extractable petroleum hydrocarbons.

2.4.1 Selection Criteria for Chemicals of Concern

Chemicals detected in the soil were reviewed for possible selection as a contaminant of potential concern. A detected contaminant is eliminated from further consideration as a chemical of concern if one or more of the following conditions apply:

1. It is detected infrequently, usually in only one or two samples, and there is no previous information indicating that it was used on the site.
2. It is detected only at concentrations less than three times the method detection limit.
3. It is not a site-related contaminant, but instead is a laboratory contaminant or a metal at concentrations within background levels based on surveys of their natural abundance in non-industrial areas in California or NAS Alameda base-wide.
4. It is detected at concentrations less than the conservative risk-based preliminary remediation goals (PRG) for a residential scenario derived by EPA Region 9 and DTSC.
5. It is an essential nutrient for animals or plants such as copper, iron, calcium, magnesium, manganese, sodium, and zinc.

2.4.2 Screening for Chemicals of Concern

Samples were screened for each group of chemicals as follows:

VOCs

No VOC was identified as a chemical of concern. All the VOC chemicals detected were eliminated as contaminants of concern because of their infrequency and their concentration were three orders of magnitude (1000 times) less than the PRGs.

SVOC

All SVOCs were eliminated because of their infrequency except for bis-2(ethylhexyl)phthalate (bis-EHP). However, bis-EPH is commonly used as a plasticizer and a laboratory contaminant.

Bis-EHP above the PRG was found in one of the 134 samples and in field blanks at 0.66 ppm. Thus, bis-EHP appears to be a laboratory contaminant or at worst indicate localized hits from plastic debris in soil samples. Therefore, bis-EHP is not a site-wide chemical and is not considered a contaminant of concern at the site.

Pesticides/PCB

All the chlorinated pesticides detected were eliminated as contaminants of concern because of the low frequency of hits for the BHCs, DDT, and glyphosate compounds. <u>PCBs including Aroclor 1248, 1254, and 1260 were detected above their respective PRG in several samples and hence are included as chemicals of concern.</u>

Metals

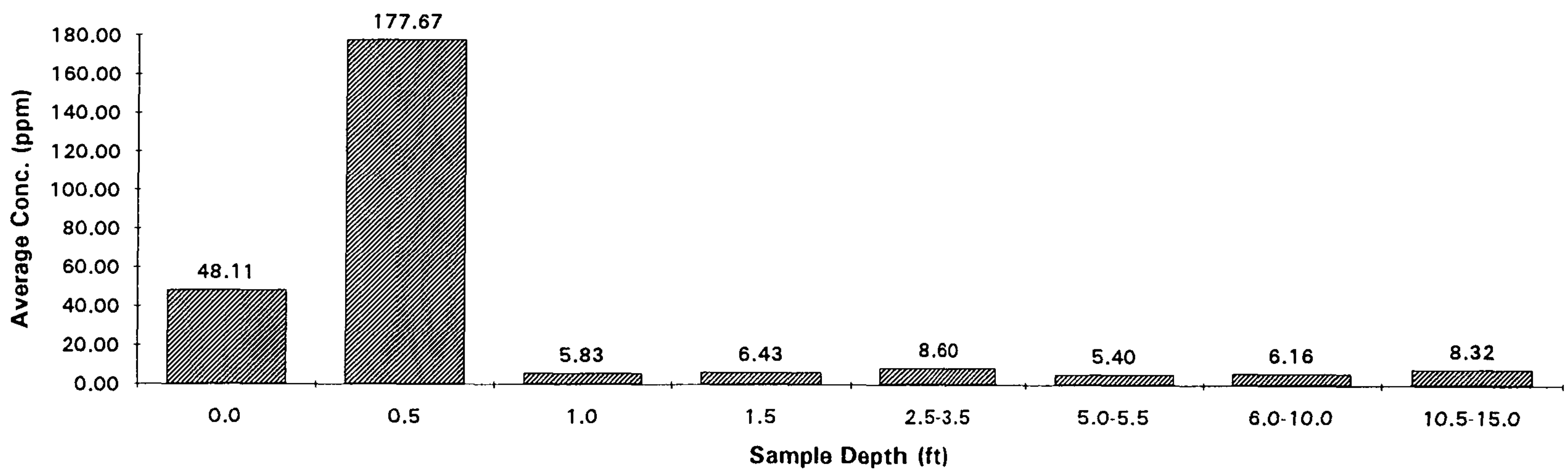
All metals except for beryllium, cadmium, lead, manganese, and thallium were eliminated because the highest concentrations detected were less than background levels or less than their respective PRGs. Further comparison of the frequency of occurrence of cadmium and thallium samples above PRG indicate localized hits and do not represent a site-wide distribution. Although beryllium was considered a potential COC, the background concentration of beryllium (0.84 ppm) was higher than the maximum found at Site 16 (0.70 ppm). Therefore, beryllium is recommended for evaluation on a base-wide level. Manganese is an essential micronutrient to plants and animals. Thus, the only site-specific metal of concern is lead.

2.4.3 Distribution of Chemicals of Concern

Soil Lead

Vertical distribution of elevated lead concentrations appears restricted to depths of less than one foot below ground surface (Figure 2-7: Concentration of lead at various sample depths [Total of 134 samples]). Below 1 foot, the average lead concentration of 9.0 ppm or less is less than the background concentration. Average lead concentration at 0.5 foot is 177 ppm. The lateral extent of elevated lead is depicted by the four areas containing greater than 300 ppm in Figure 2-5, Lead 300 ppm Concentration Contour. The distribution of lead in soil may be natural or reflect past disposal of possibly paint thinner used to strip lead paints, or lead paint, or or the application of used motor oil as a weed killer.

Figure 2-7 **Site 16 - Concentrations of Lead at Various Sample Depth (Total of 134 Samples)**



Soil PCB

Vertical distribution of elevated PCB concentrations (specifically Aroclor 1248, 1254, and 1260) is restricted to depths of less than one foot bgs (see Figure 2-8, Average Concentration of Total PCBs at Various Depth). Average PCB concentration at 1 foot is 0.066 ppm, which equals the residential PRG for total PCBs. Average PCB concentration at 0.5 foot is 1.835 ppm (if half the detection limit values are used for samples reported as none detected for PCBs). PCBs were also detected in storm drain samples in concentrations as high as 0.8 ppm. However, a significant number of samples were reported as none detected, with 17 of 134 samples reported to contain above various detection limits. Three areas have elevated PCB concentrations above 1 ppm (Figure 2-4, PCB 1 ppm Concentration Contour). The NW affected area contains primarily Aroclor 1260 PCBs. The other two affected areas are exclusively Aroclor 1254 PCB. The distribution of elevated PCB concentrations appears to indicate that the NW affected area contains residues of transformer leaks, as reported in the historical data, and was probably a staging area for the use of PCB oil as weed controller. Aroclor 1254 was detected only in the two other affected areas, which suggests the storage of PCB-containing equipment in those locations.

2.4.4 Data Quality

Data collected by Canonie in 1990 did not meet NAVY Level D or EPA's CLP reporting requirements. As such, quality control data for precision, accuracy, representativeness, completeness, and comparability (PARCC) for laboratory and field data were not reported.

PCB Data

Data precision could not be validated for the 1990 PCB data, especially for samples reported with high (greater than 0.5 ppm) detection limits for the Aroclors and the SVOCs. Fifty of the 134 samples in the data pool were reported with a detection limit of 0.5 or greater for non-detect PCB samples. Thirty-eight of the 134 samples analyzed had detection limits for PCB samples greater than 1.0 ppm (Figure 2-9).

Thallium Data

Data summarized in the Tables of the 1990 Canonie report were not correct. The laboratory analysis mis-reported sodium concentrations as thallium.

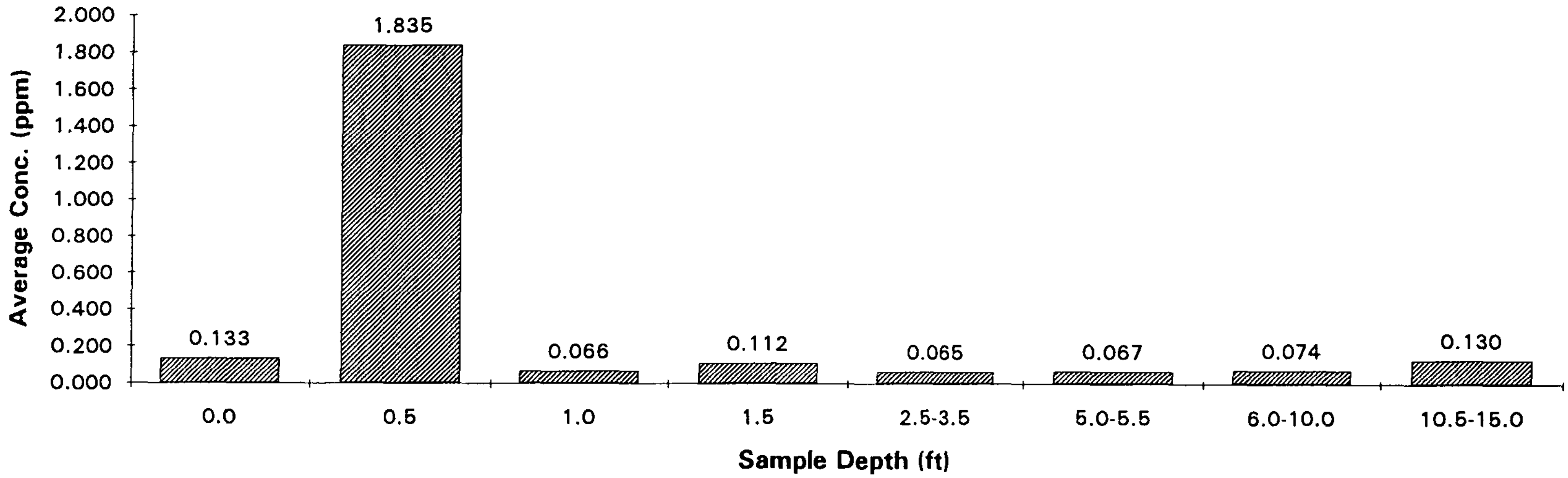
Bis-2(ethylhexyl)phthalate Data

Laboratory quality control sample results were reported by only one out of the three laboratories that analyzed for SVOC for the 1990 samples. The reporting laboratory had detected bis-EHP in the laboratory blanks in significant concentrations (as high as 0.66 ppm). This indicates that bis-EHP was a laboratory contaminant rather than a contaminant at the site.

Oil and Petroleum Hydrocarbon Data

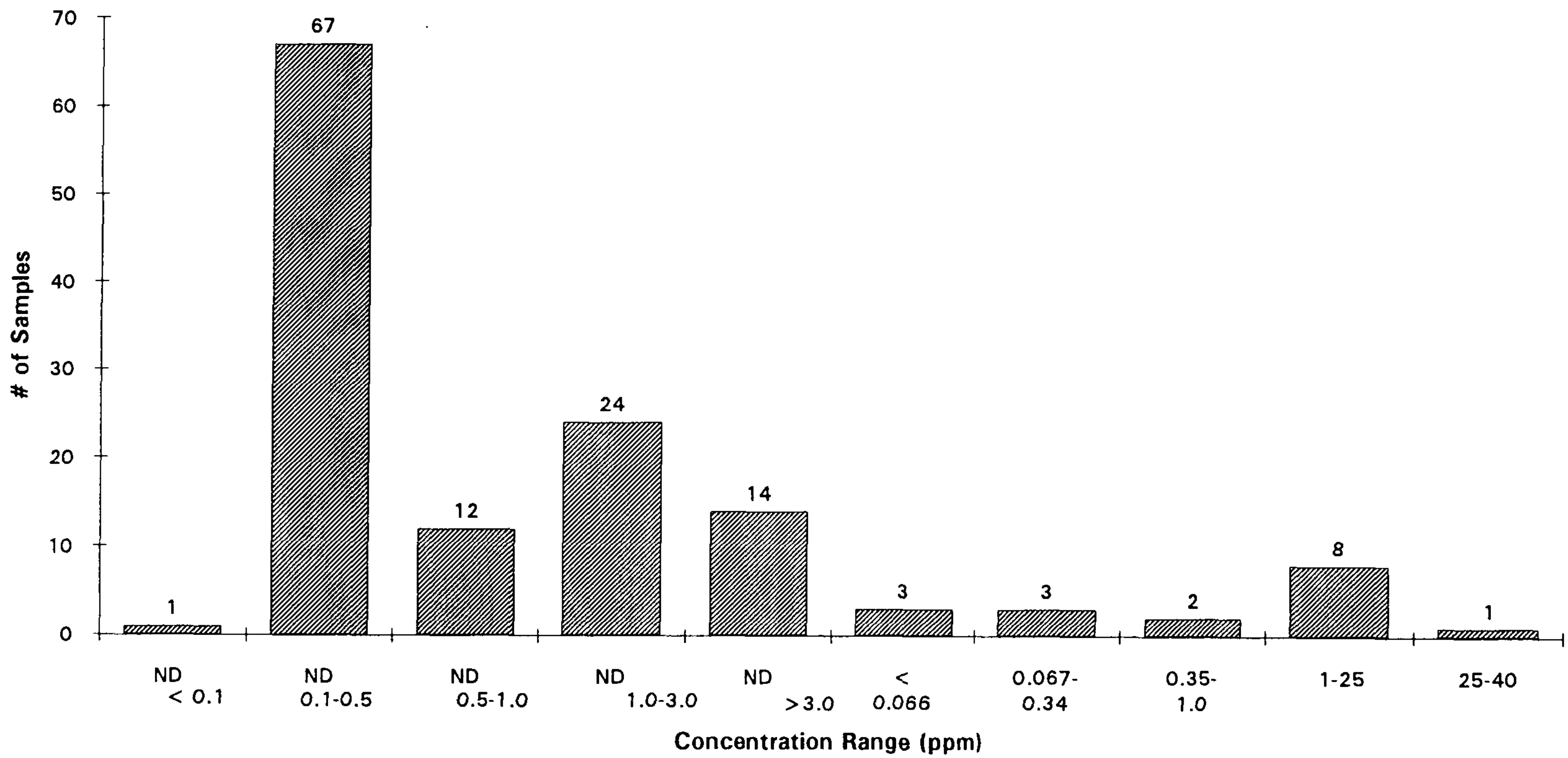
Historical site use information indicates that paint thinners were stored and PCB oils used as herbicides. Current site conditions show visual oily patches on surface soil. Previous investigation did not analyze for oil and paint thinner; hence the sample analysis is considered incomplete. Furthermore, results collected cannot be compared to site use data for paint thinners and oil; hence historical investigation data is not comparable to chemical-use information.

Figure 2-8 Site 16 - Average Concentration of Total PCBs* at Various Sample Depth (Total of 135 Samples)



*: Total PCBs was calculated by using half of the detection limits with a maximum conc. of 0.625 ppm to represent samples reported "ND".

Figure 2-9 **Site 16 - Distribution of PCB Concentrations (Total of 135 Samples)**



2.5 STREAMLINED RISK EVALUATION

The chemicals of concern, lead and PCBs, are distributed in residual surface soil at Site 16 at concentrations exceeding their respective PRGs. The residential/industrial CAL-Modified soil PRGs for lead are 130/250-400 ppm, while the residential/industrial soil PRG for PCB are 0.066/0.34 ppm. The PRGs are health-based concentrations that correspond to either a one-in-one-million (10^{-6}) cancer risk or chronic hazard quotient of one, whichever is lower. The conceptual site model (CSM) used to develop health risk-based PRGs for soil were based on incidental ingestion and dermal contact exposure pathways for 30-years occupancy by on-site residents (residential) or worker (industrial) of residual chemical-affected soil. Other exposure pathways not used in the PRG CSM that may be applicable to Site 16 include (a) potential ecological concern and (b) fugitive dust to downwind offsite areas.

The Conceptual Site Model (CSM) for current and future use scenarios for Site 16, shown in Figure 2-10, indicates the following:

Source areas

Current source areas include surface soil containing over 300 ppm lead and/or 1.0 ppm total PCBs. However, most of the area is covered with runway perforated steel plates.

Future source areas (post removal action) should contain residual surface soil containing an average of less than 130 ppm lead and/or less than 0.34 ppm total PCBs without the perforated runway steel plates.

Exposure Pathways

Current exposure pathways include on-site incidental ingestion and dermal contact by workers and off-site fugitive dust inhalation (minimized by the runway steel plates and oil on the surface soil) and ecological impacts from surface soil erosion through storm drains to the San Francisco Bay.

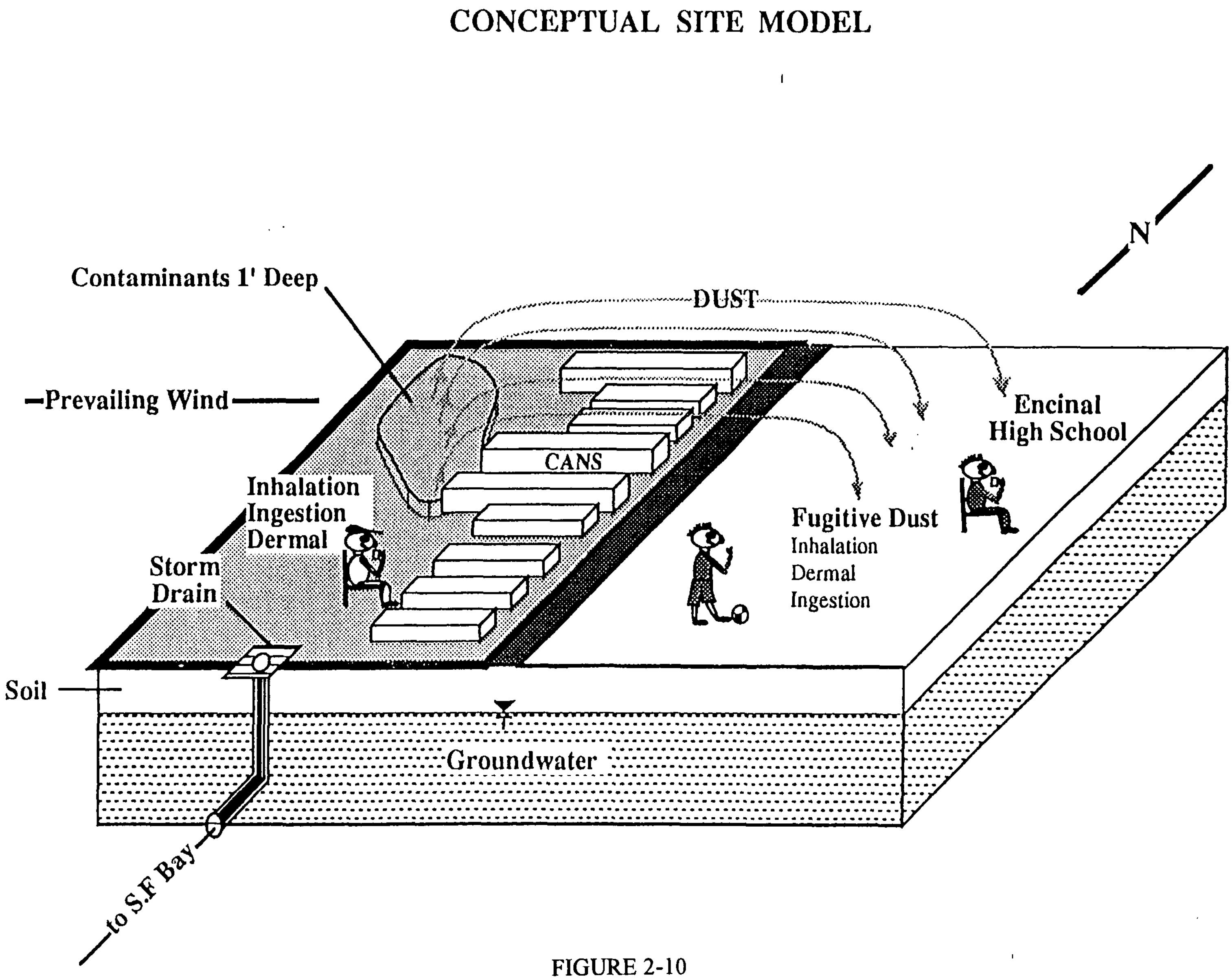

CONCEPTUAL SITE MODEL
N
Contaminants 1' Deep
DUST
Prevailing Wind
CANS
Encinal
High School
Inhalation
Ingestion
Dermal
Fugitive Dust
Inhalation
Dermal
Ingestion
Storm
Drain
Soil
Groundwater
to S.F Bay

FIGURE 2-10

Future exposure pathway (post removal action) may include onsite and offsite fugitive dust, incidental ingestion (and on-site pica activity for residential use only), dermal contact, impact to groundwater, storm water impact, and ecological concerns.

Potential Receptors

Current potential receptors include onsite workers, downwind off-site residents, nearby schools and workers, and San Francisco Bay fauna and flora.

Future potential receptors include on-site workers or residents, down-wind off-site residents, nearby schools and workers, and San Francisco Bay fauna and flora.

Removal of surface soil containing elevated concentrations of lead and PCBs may reduce the cancer risk for future unrestricted use of Site 16 by one to two orders of magnitude (10 to 100 times).

2.5.1 Previous Risk Assessments and Evaluations

No previous risk assessments have been conducted for Site 16. Conditions at the site meet the following NCP requirements for a removal action (40 CFR 300.415(b)(2)). The criteria that are applicable include:

- (i) Actual or potential exposure to nearby human populations, animals, or the food chain from hazardous substances or pollutants or contaminants.
- (iv) High levels of hazardous substances or pollutants or contaminants in soils largely at or near the surface, that may migrate.
- (v) Weather conditions that may cause hazardous substances or pollutants or contaminants to migrate or be released.

2.5.2 Health Effects of Lead and PCBs on the Human Population and Environment

Lead

Chronic exposure to lead generally results in 90% accumulation in the bones. Lead impairs the formation of red blood cells largely by inhibiting hemsynthetase and d-ala-dehydratase. Chronic lead poisoning results in anemia and lead encephalopathy. Symptoms include headache, giddiness, insomnia, amblyopia, deafness, depression, stupor, tremor, mania, delirium, convulsions, paralysis, ataxia, and coma. A neuromuscular syndrome called "lead palsy" may be evident. Acute toxicity is most common in young children with history of pica. Anorexia, vomiting, malaise, or convulsions due to increased intracranial pressure may occur. May leave permanent brain damage if blood lead is increased above 0.05%. Chronic toxicity is shown in children by weight loss, weakness, or anemia. Lead poisoning in adults is usually occupational due mainly to inhalation of lead dust or fumes. Wristdrop and colic rarely occur.

PCBs

PCBs are highly persistent and bio-accumulate as pollutants. Chronic toxicity to the liver from long-term exposure is reported. At high doses, it causes suppression of the immune system, reproductive dysfunction, birth defects, and liver tumors. It is a suspected carcinogen.

Toxic effects in humans include chloracne, pigmentation of skin and nails, excessive eye discharge, swelling of eyelids, distinctive hair follicles, gastrointestinal disturbances. Toxic symptoms in animals include hepatocellular carcinoma, hypertrophy of the liver, adenofibrosis, weight and hair loss, mouth and eyelid edema, acneform lesions, decreased hemoglobin and hematocrit, gastric mucosal ulceration, and reduced ability to reproduce. PCBs may reasonably be anticipated to be carcinogens.

2.5.3 Documented Exposure Pathways

No pathway has been documented for Site 16.

2.5.4 Sensitive Population

Sensitive populations at this site include children at the neighboring Encinal High School and the only sensitive endangered species on NAS, Alameda, the California least tern (*Sterna albifrons browni*). Other sensitive species lists compiled for the San Francisco Bay must be considered because of stormwater impacts on the bay.

3.0 IDENTIFICATION OF SOIL REMOVAL ACTION OBJECTIVES

3.1 STATUTORY FRAMEWORK

This removal action is taken pursuant to CERCLA and the NCP under the delegated authority of the Office of the President of the United States by Executive Orders 12080 and 12580. These orders to provide the U.S. Department of the Navy with authorization are non-time-critical because a six-month planning period was available from the time the removal action was determined to be necessary before the initiation of removal actions.

This EE/CA/RAW complies with the requirements of CERCLA, SARA, NCP at 40 CFR Part 300, DERP at 10 USC Sec. 2701, et seq., and EO 12580. This EE/CA/RAW is being pursued under 40 CFR Part 300.415(b)(2):

(i) Actual or potential exposure to nearby human populations, animals, or the food chain from hazardous substances or pollutants or contaminants

(iv) High levels of hazardous substances or pollutants or contaminants in soils largely at or near the surface, that may migrate

(v) Weather conditions that may cause hazardous substances or pollutants or contaminants to migrate or be released

The requirements for this EE/CA/RAW and its mandated public comment period provide opportunity for public input to the cleanup process. The entire process is also governed by the NAS Alameda FFA signed by the DON, EPA, DTSC (formerly Department of Health Services (DHS)), and SFBRWQCB.

3.2 DETERMINATION OF REMOVAL SCOPE

The physical removal and treatment of PCB-and lead-contaminated soil are not anticipated to exceed 1 month in duration at a cost not in excess of $600,000. The medium that will be subject to a removal action consists of soils containing PCBs above 1 ppm and lead above 300 ppm.

This removal action does not attempt to remediate other contamination at the site, such as dissolved components in groundwater. This removal action would minimize the need for other removal actions (restarts) to protect health, welfare, and the environment prior to implementation of the final remedial treatment chosen through the RI/FS process.

3.2.1 Recommended Action Levels

Three types of Action Level were considered for this EE/CA/RAW: Removal Action Level; Average Residual Level; and Treatment Level. The Removal Action Level is the concentration above which is subject to remediation under this EE/CA/RAW. The average residual level is the average concentration in residual soil following completion of removal action. The treatment level is the concentration in soil following soil treatment for on-site replacement at the site.

The recommended Removal Action Level for lead is 300 ppm. However, as a result of the distribution of lead in soil at the site, Average Residual Level of lead following soil removal is projected at less than 130 ppm (see Table 3-1). Any soil treatment and placement of treated soil at the site will also be no greater than the Average Residual Lead concentration of 130 ppm (Residential PRG). Similarly, the Removal Level for PCBs is 1.0 ppm. However, based on the historical PCB distribution at Site 16, the Average Residual Level of PCB is projected to be between 0.066 - 0.34 ppm (residential and industrial PRG for Aroclor 1260). The recommended Treatment Level for PCB for onsite placement is 0.34 ppm (industrial PRG).

3.3 DETERMINATION OF REMOVAL SCHEDULE

The schedule for the contaminated soil removal action to be conducted within Site 16 have been developed as part of an EE/CA Approval Memorandum. A preliminary schedule was presented as part of the Approval Memorandum. The schedule for the above referenced removal actions is presented in Figure 3-1. An Implementation Work Plan will be prepared containing details of schedule, health, safety, and engineering controls for the selected removal action alternative.

3.4 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

The NCP states, "Removal actions . . . shall to the extent practicable considering the exigencies of the situation, attain applicable or relevant and appropriate requirements under federal environmental or state environmental or facility citing laws." [40 CFR 300.415(i)]

The evaluation of applicable or relevant and appropriate requirements for this EE/CA can be found in Appendix B. The following sections provide an overview of the ARARs process and a summary of those ARARs that potentially affect the development of removal action objectives.

Statutory and regulatory ARARs that will affect the handling, treatment, and final disposition of media containing contaminants of concern identified at the Site 16 include:

Federal
- SARA
- TSCA

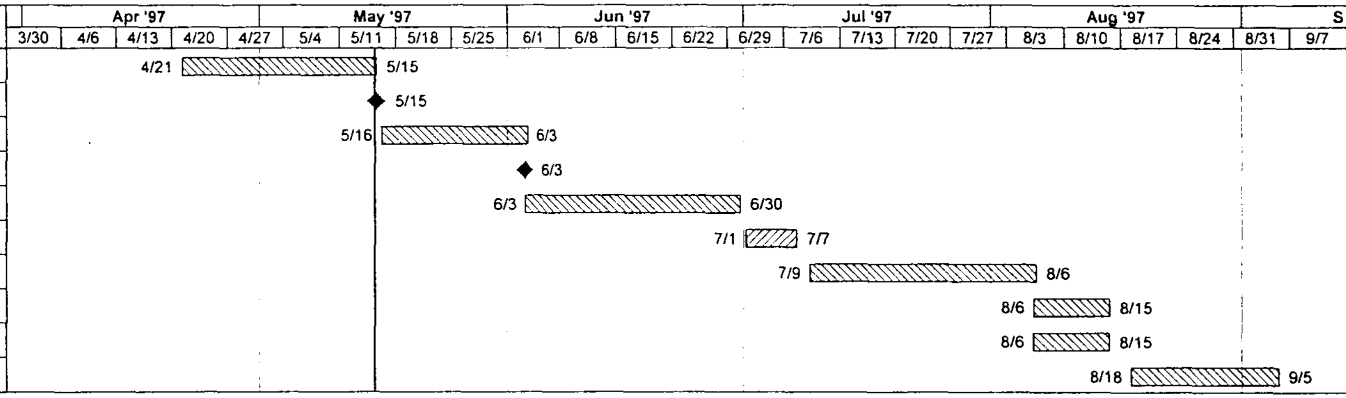
Table 3-1
Site 16 - Action Level Summary

CONTAMINANTS	PURPOSE	PROPOSED *REMOVAL* ACTION LEVEL	PROJECTED AVERAGE *RESIDUAL* LEVEL	GOAL OF *TREATMENT* FOR ON-SITE PLACEMENT
LEAD	CLEANUP	300 ppm	< 130 ppm	(1) 130 ppm (2) < STLC
	PRIMARY ARARS	CAL PRG Commercial (250 - 400 ppm)	CAL PRG Residential (130 ppm)	(1) CAL PRG Residential (130 ppm) (2) Title 22 STLC (Soluble < 5 mg/L)
PCB	CLEANUP	1.0 ppm	0.066 - 0.34 ppm	0.34 ppm
	PRIMARY ARARS	TSCA Clean (1.0 ppm)	EPA PRG Residential (0.066 ppm) EPA PRG Commercial (0.34 ppm)	EPA PRG Commercial (0.34 ppm)

Date: 06/19/95

Figure 3-1
Site 16 EE/CA Schedule
NAS Alameda

ID	Name	Duration
1	Prepare Revised Pre-draft EE/CA	19d
2	RAB Presentation	0d
3	Regulatory Agency/RAB Review	13d
4	Regulatory Agency/RAB Comments	0d
5	Prepare Draft Final EE/CA	20d
6	Draft Final Review	5d
7	Public Notice	4.2w
8	Action Memorandum	8d
9	Final EE/CA	8d
10	Construction Oversight	15d



Project:
Date: 5/15/97

Critical Noncritical Progress Milestone Summary Rolled Up

- 40 CFR part 50
- 40 CFR part 264

State of California and Local Agencies
- CCR Title 22
- CCR Title 23
- CCR Title 8
- CCR Title 14
- Bay Area Air Quality Management District Regulations

Primary ARARS used to assess removal action goals are summarized in Table 3-1, and include:

Federal
- USEPA guidance for clean-up of PCB-affected sites
- USEPA Region IX PRGs
- USEPA discretionary guidance for site-specific clean-up of PCBs

State of California
- PRGs

APPLICABLE AND RELEVANT ARARs

The following federal regulations are identified as potential ARARs for the removal action at TSTA:

Subchapter R - Toxic Substances Control Act, 40 CFR Part 761 -Polychlorinated Biphenyls Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions. Lists the requirements for the handling and cleanup of PCBs. Requires that any PCB-contaminated soil be handled and disposed of in accordance with 40 CFR 761. If soil is removed, the soil used to replace the excavation must contain less than 1 ppm PCB.

40 CFR Part 50 - National Primary and Secondary Ambient Air Quality Standards. Lists the ambient air quality standards for particulate matter for 24 hours (150 micrograms per cubic meter) and the annual arithmetic mean average (50 micrograms per cubic meter). The standards are measured as PM10 and are applicable for excavation or other activities that may generate air emissions (e.g., fugitive dust). Air monitoring may be required to ensure that air quality is not impacted.

CCR Title 22 - Social Security, Division 4.5 - Environmental Health Standards for the Management of Hazardous Waste. This Title represents the State Resource Conservation and Recovery Act (RCRA) regulations authorized under USEPA; therefore, it is considered a potential federal ARAR. The chapters of this Title discuss the proper characterization, handling, and disposal of any hazardous waste identified or generated at the site. Chapter 18 identifies hazardous wastes that are restricted from land disposal and defines those limited circumstances under which an otherwise prohibited waste may continue to be land disposed. The requirements of this chapter shall not affect the availability of a waiver under Section 121(d)(4) of CERCLA.

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). Section 66268.29 lists PCB waste as being restricted from land disposal. Section 66268.41 and 66268.43 list treatment standards and/or waste concentration limits for land-disposal of contaminants including PCBs. It should be noted that although TSTA soils contain detectable concentrations of PCB, the concentrations of the samples analyzed are well below hazardous waste criteria promulgated in this regulation. Nevertheless, the products generated by remedial actions may have concentrations of COCs that exceed hazardous waste criteria.

CCR Title 23 - State Water Resources Control Board, Chapter 15 -Discharge of Waste to Land. This Title/Chapter include regulations which pertain to water quality aspects of waste discharge to land and in particular the requirements for waste treatment and storage that will effect how the proposed TSTA is to be constructed.

Bay Area Air Quality Management Regulations. The Bay Area Air Quality Management District Regulation 2 requires that permits be obtained for treatment of PCBs. Regulation 6 restricts particulate emissions. Regulation 11, Rule 1 restricts emissions of particulate containing lead.

CCR Title 8 - General Industry Safety Order. This Title represents the state occupational health and safety regulations. Section 5155 limits 8-hour time-weighted averages for nuisance dust to 10 milligrams per cubic meter and Section 5216 limits 8-hour time weighted averages for lead emissions to 50 micrograms per cubic meter.

TO-BE CONSIDERED ARARS

To-be considered regulations and/or guidance documents considered pertinent to the removal action at the TSTA are identified below. These documents were used in the development of removal action alternatives and contaminant action levels.

California Health and Safety Code. Senate Bill 1706 recently amended the California Health and Safety Code. Specifically, Sections 25356.1 and 25358.9 were amended, and Section 25323.1 was added. Substantive provisions of the amendments include the conditions and requirements for which preparation of a removal action workplan (RAW) is applicable for non-emergency removal actions. The removal action work plan shall include a description of the on-site contamination, the goals to be achieved by the removal action, any alternative removal actions that were considered and rejected and the basis for that rejection, and a detailed engineering plan. Compliance with these provisions is summarized below:

Requirement	Documentation
Description of On-site Contamination	EE/CA - Section 2.0
Removal Action Goals	EE/CA - Section 3.0
Alternatives Considered and Rejected	EE/CA - Section 4.0
Identification of Removal Action	EE/CA - Section 5.0
Detailed Engineering Plan	EE/CA - Section 6 and Implementation Work Plan

USEPA Region IX PRGs [USEPA 1995]. These PRGs are risk-based values used to predict single-contaminant risks for specific media. While these values do not represent stringent cleanup criteria, they are a useful tool in screening data to identify contaminants that should be evaluated in greater detail. A PRG residential scenario of 400 ppm is established for lead. A PRG residential scenario of 66 parts per billion (ppb) and a commercial scenario of 340 ppb is established for Aroclor 1260. PRGs for the other site Aroclors detected at the site allow higher concentrations.

Guidance on Remedial Actions for Superfund Sites with PCB Contamination [USEPA 1990]. This document recommends a 1 ppm soil action level for PCB when remediating contaminated soils for residential land use. The action level is determined by a risk-based calculation that considers ingestion, inhalation, and dermal contact as the exposure pathways.

CAL-EPA PRGs. The CAL-EPA has different PRGs for lead, which are risk-based values used to predict single-contaminant risks for specific media. While these values do not represent stringent cleanup criteria, they are a useful tool in screening data to identify contaminants that should be evaluated in greater detail. A PRG residential scenario of 130 ppm and 250 - 400 ppm industrial scenario are established for lead. However, these levels are subject to revision based on site-specific conditions and the extent of the lead problem at the site.

40 CFR Part 264 - Standards for Owners and Operators of Hazardous Waste Treatment , Storage , and Disposal Facilities, Subpart S Corrective Action for Waste Management Units. This subpart describes requirements for USEPA oversight and discretionary authority for construction of Corrective Action Management Units (CAMU). Although not directly applicable to the TSTA Area, as soil at site is not a hazardous waste or a RCRA waste, the standards in this sub-part were applied to the construction of the TSTA.

CCR Title 22 - Social Security, Division 4.5 - Environmental Health Standards for the Management of Hazardous Waste. Requirements of Article 15.5, are similar in content and relevancy to the requirements of 40 CFR Part 264 as pertains to the construction of a TSTA; as detailed previously.

CCR Title 14 - Natural Resources, Division 7-California Waste Management Board, Chapter

3- Minimum Standards for Waste Management and Chapter 5- Enforcement of Solid Waste Management Standards and Administration of Permits. This Title and Chapters set forth requirements for closure, post-closure, and certification workplans and work to be conducted for closing landfills. These requirements would be applicable and relevant to the on-site disposal alternative, at the West Beach Landfill, if this alternative was selected.

3.5 REMOVAL ACTION OBJECTIVES

The specific objectives of the removal are as follows:

- Removal of soils contaminated with PCBs above 1 ppm and lead above 300 ppm.
- Residual soil testing to verify residual PCB less than 0.34 ppm and lead less than 130 ppm.
- On-site treatment and disposal of contaminated soil; specifically, the removal of PCB, lead, and decomposition products from the soil in accordance with accepted ARARs.
- Reduction of the health risk of Site 16 to allow for unrestricted future use.
- Remediation and reuse NAS Alameda of treated soils generated by the removal action.
- Completion of these actions without undue interference to the active base operation.
- Completion of these actions in the shortest practical time period.

4.0 IDENTIFICATION AND SCREENING OF GENERAL REMOVAL ACTIONS AND TECHNOLOGIES

To achieve the removal action objectives described in Section 3.5, site-specific data from the site characterization were reviewed so that potential alternatives could be identified, developed, and evaluated. The removal action alternative development and evaluation process proceeded as follows: First, applicable general removal actions and technologies were identified and screened with respect to site-specific data. Second, candidate removal actions were developed from the initial screening. Third, the alternatives were evaluated based on effectiveness, implementability, and cost and compared with one another to identify a preferred alternative. Section 4.1 summarizes the general removal actions and treatment technologies that were identified and screened for this removal action. The removal action alternatives are developed in Section 4.2 and evaluated in Section 4.3.

Alternatives are evaluated assuming PCB and lead contamination only. Other organic compounds and inorganic products were not identified as primary contaminants in previous investigations and are not considered within the scope of this removal action. Other compounds not addressed as part of this removal action will be evaluated as part of the RI/FS for the NAS Alameda Complex. An initial discussion of potential alternatives and applicable technologies in this section will be followed by a more detailed analysis of the four selected options including their effectiveness, implementability, and cost.

The effectiveness criteria used were the following: (a) protection of human health and the environment; (b) ability to achieve the target cleanup levels; in other words reduction of toxicity, mobility, or volume through the removal action; (c) compliance with ARARs and other guidance; and (d) long- and short-term effectiveness of the alternative.

The implementability criteria were the following: (a) technical feasibility, including commercial availability; (b) administrative feasibility; (c) availability of services and materials; and (d) regulatory agency and public acceptance.

The cost evaluation of each alternative is based upon estimates of capital costs and operation and maintenance costs.

4.1 IDENTIFICATION OF POTENTIAL TECHNOLOGIES

Potential technologies are those which are appropriate for the site contaminants and may achieve the specific objectives, but may not necessarily be technically effective, successfully implementable, or cost-effective. A wide range of potential technologies was initially considered to ensure that no reasonable alternative was overlooked. Six general removal actions which may be applicable to Site 16 were considered based on the screening criteria defined above. The waste treatment processes associated with each removal action were also evaluated based on their technical feasibility and effectiveness. The general removal action and technologies/ processes that were screened are shown in Tables 4-1 and 4-2. If any of the potential technologies options failed the technical feasibility, effectiveness, or implementability criteria, it was dropped from further consideration. The last two columns of Table 4-1 show the initial screening decision and the basis for each remedial technology considered. A detailed description of the screened technologies is presented in Appendix C.

Table 4-1

GENERAL REMOVAl ACTION AND TECHNOLOGY SCREENING SUMMARY
SITE 16 - CANS - 2 AREA

General Response Action/Process	Remedial Technology /Process	Effectiveness	Implementability	Estimate Cost	Initial Screening Decision	Comments
No Action	No Action	Low	Good	Low	Consider	Serves as baseline, contaminants remain indefinitely
Institutional Controls	Deed Restrictions	Low	Good	Low	Eliminate	Minimal protection to human health and the environment, not permanent soil remediation solution
	Fencing	Low	Good	Low	Eliminate	
Containment Actions	Capping	Low	Good	Low	Consider	These actions prevent exposure and further migration however, they provide only limited protection to human health and the environment and limit future land use
	Vertical Barriers	Low	Moderate	Moderate	Eliminate	
	Horizontal Barriers	Low	Moderate	Moderate	Eliminate	
	Surface Controls	Low	Good	Low	Eliminate	
Removal/Disposal Actions	Excavation	High	Good	Moderate	Consider	Effective, easy to implement
	On-Site Backfill	Moderate	Moderate	Low	Consider	Community resistance
	Class I Disposal	High	Good	High	Consider	Can pretreat for lead and PCBs prior to disposal
	Class II Disposal	Moderate	Good	Moderate	Consider	Case by case acceptance of waste
	Class III Disposal	Low	Difficult	Low	Eliminate	Soils do not meet stringent facility acceptance criteria
	Recycler	Low	Difficult	Low	Eliminate	Lead and PCB concentrations too high for acceptance
In Situ Action	Solidification/Stabilization	Moderate	Moderate	Low	Consider	Immobilizes lead may immobilize PCBs
	Aerobic Bioremediation	Low	Moderate	Moderate	Eliminate	Not proven effective for all PCBs, not effective for lead
	Anaerobic Bioremediation	Low	Difficult	Moderate	Eliminate	Not feasible in shallow soil (<2 ft bgs) nor for lead
	Vitrification	High	Difficult	Very High	Eliminate	Complex technology, very high costs
Ex Situ Actions	Soil Washing	Moderate	Moderate	Moderate	Consider	Effective for removing lead and potential PCBs
	Acid Washing	Moderate	Moderate	Moderate	Consider	Effective for removing lead, not effective for PCBs
	Solvent Extraction	Moderate	Moderate	Moderate	Consider	Effective for removing PCBs and potentially lead
	Slurry-phase Bioremediation	Moderate	Moderate	Moderate	Consider	Effective for removing PCBs, not effective for lead
	Controlled Solid-phase Biotreatment	Low	Difficult	Low	Eliminate	Not effective for lead, lead toxic to microbes
	White-rot Fungus	Low	Difficult	Moderate	Eliminate	Not proven technology, not effective for lead
	Solidification/Stabilization	Moderate	Moderate	Moderate	Eliminate	In-Situ more cost effective
	Chemical Dechlorination	Low	Difficult	High	Eliminate	Effective for PCBs, not effective for lead
	Ultrasonic Detoxification	Low	Difficult	High	Eliminate	Not proven technology, not effective for lead
	Incineration	Moderate	Good	High	Eliminate	Proven for PCBs, but not lead, very high costs
	Thermal Desorption	Moderate	Difficult	Moderate	Eliminate	Proven for PCBs not lead, difficult for site-specific soil
	Pyroplasmic	Low	Difficult	High	Eliminate	Not effective for solid wastes or lead
	Photo Dehalogenation	High	Good	Moderate	Consider	Effective for PCBs, not effective for lead

Date: 07/10/95

07/10/95

Proj. #: 95A1601

NAVAL AIR STATION, ALAMEDA
SITE 16 - CANS-2 AREA
WASTE TREATMENT PROCESS SCREENING

TABLE 4-2

General Response Action	Treatment Process	Contaminant Treated	
		PCB	Metal
No Action	Do Nothing		
Contaminment Actions	Capping	●	●
	Encapsulation	●	●
In-Situ Treatment Actions	Electrolytic Recovery Techniques		●
	Air Stripping & Steam Stripping	●	
	Evaporation		
	Physical and Chemical Fixation	●	●
	Aerobic Process	●	
	Anaerobic digestion		
	Enzymatic Treatment		
	Thermal Desorption	●	
	Detoxification	●	
Ex-Situ Treatment Actions	Activated Carbon Adsorption	●	
	Distillation		
	Electrolytica Recovery Techniques		●
	Hydrolysis		
	Ion Exchange		●
	Solvent Extraction	●	
	Membrane Separation Technolgy		
	Air Stripping & Steam Stripping	●	
	Freeze Crystallization		
	Filtration and Separation	●	●
	Chemical Precipitatoin		●
	Thin-film Evaporation		

General Response Action	Treatment Process	Contaminant Treated	
		PCB	Metal
Institutional Control Actions	Natural Attenuation	●	
Removal & Disposal Actions	Excavation & Land Disposal	●	●
Ex-Situ Treatment Actions	Dehalogenation	●	
	Ozonation		
	Evaporation		
	Physical & Chemical Fixation	●	●
	Liquid-injection Incineration		
	Rotary Kilns Incineration	●	
	Fluidzed Bed Thermal Oxidation		
	Wet Oxidation		
	Pyrolysis	●	
	Supercritical Fluid Extraction		
	Plasma System		
	Incineration	●	
	Catalytic Incineration		
	Aerobic Process	●	
	Surfactant Washing	●	
	Abaerobic Digestion		
	Enzymatic Treatment		
	Photolysis	●	
	Chemical Oxidation & Reduction		
	Termal Desorpation	●	
	Detoxification	●	

References:

1. EPA Document, 1993; Remediation Technologies Screening Matrix and Reference Guide, Version I.

2. DHS/TSCD Third Biennial Report, 1986; Alternative Technologies for Recycling and Treatment of Hazardous Wastes

3. Freeman, Harry M.; Standard Handbook of Hazardous Waste Treatment and Disposal

4.2 DEVELOPMENT OF REMOVAL ACTION ALTERNATIVES

Following the screening of general removal actions and technologies, demonstrated and potentially applicable technologies were considered from the screened generalized classes of removal action alternatives for the soils at Site 16. These classes include:

* No Action

* Containment Actions
  - Capping

* Removal and Disposal Actions
  - Excavation
  - On-Site Disposal
  - Class I Facility Disposal
  - Class II Facility Disposal

* In-Situ Treatment Actions
  - Solidification or Stabilization (Fixation)

* Ex-Situ Treatment Actions
  - Soil Washing
  - Acid Washing
  - Solvent Extraction
  - Slurry-phase Bioremediation
  - Photolytic dehalogenation
  - GAC Adsorption
  - Clarification/Filtration

The technologies within the classes may not individually satisfy the site-specific removal action objectives. It was thus necessary to assemble and group them to form site-specific removal action alternatives. Certain technologies are necessarily associated with other technologies. For example, depending on the concentration of constituents in the excavated soils and the applicability of Land Disposal Requirements (LDRs), excavated soils may require treatment before disposal. The following specific removal action alternatives were assembled for remediating soils at Site 16 at NAS Alameda based on the results of the technologies screening:

Alternative 1 - No Action

Alternative 2 - On-Site Treatment with Solvent Extraction and Acid Washing

Alternative 3 - Off-Site Disposal at a Class II Landfill

Alternative 4 - Disposal at NAS Site 2 (West Beach Landfill)

4.2.1 Description of Removal Alternatives

Alternative 1: No Action

Alternative 1 is to leave the site as is, to take no action affecting the contaminants, and not to conduct periodic inspection or monitoring of ambient air and groundwater.

Alternative 2 Excavation, Soil Washing and/or Solvent Extraction

Alternative 2 is to remove soil containing PCB concentrations exceeding 1.0 ppm and total lead concentrations exceeding 300 ppm; separate PCBs from soil through surfactant washing or solvent extraction; and remove soluble lead through on-site soil washing or if necessary acid washing. PCBs in wash water or solvent would be destroyed by UV oxidation or removed in beds of granular activated carbon (GAC) adsorbers. Lead removed from the metal solubilization process is disposed of off-site. Treated soil is disposed of on-site by replacing in the excavation area.

Alternative 3: Excavation and Class II Off-Site Disposal

Alternative 3 is to remove soil containing PCB concentrations exceeding 1.0 ppm and total lead concentrations exceeding 300 ppm and to dispose of the excavated soil at a Class II land disposal facility. Soil removed from the site would be replaced with clean fill soil.

Alternative 4: Excavation and Disposal at NAS Site 2 (West Beach Landfill)

Alternative 4 is to move the soil from Site 16 to an new engineered fill to be constructed at the West Beach Landfill, Site 2. This may be the permanent location of the new fill or the location may have to be moved to incorporate the fill into the final closure of the West Beach Landfill; if required by the Site 2 Closure Plan (as yet to be prepared). Soil removed from the site would be replaced with clean fill soil.

4.4 EVALUATION OF REMOVAL ACTION ALTERNATIVES

Evaluation Criteria

The identified removal action alternatives are evaluated based on three criteria: (1) effectiveness; (2) implementability; and (3) estimated costs.

Effectiveness

The effectiveness of an alternative refers to its ability to meet the cleanup objectives within the scope of the removal action. These objectives include: (1) overall protection of public health, community, and the environment; (2) ability to achieve the target cleanup levels; (3) reduction of toxicity, mobility, or volume through treatment; (4) long-term effectiveness and permanence; and (5) system reliability/maintainability. The preference of each treatment option over land disposal alternatives, where practicable treatment technologies are available is also considered.

Implementability

The implementability criteria encompass: (1) technical feasibility; (2) administrative feasibility of implementing a particular alternative; (3) availability of various services and materials required; and (4) regulatory agency and community acceptance. Technical feasibility was used to eliminate those alternatives that are clearly impractical at the TSTA. Administrative feasibility evaluates those activities needed to coordinate with other offices and agencies such as permits and waivers.

Cost

Each removal action alternative is evaluated to determine its projected costs. The evaluation compares each alternative's capital, operations and maintenance (O&M) costs. For Alternatives 2 and 3 the removal action alternative can be implemented in a relatively short period of time and associated O&M are negligible. These costs are prepared using many sources and include vendor estimates, disposal facility fees, and estimates for similar projects.

4.4 REMOVAL ACTION ALTERNATIVES

The preliminary screening resulted in four alternatives, including the no-action alternative. The analysis of each removal action alternative consists of a description of the alternative, followed by an evaluation based on its relative effectiveness, implementability, and estimated cost.

4.5 REMOVAL ACTION ALTERNATIVES

The preliminary screening resulted in four alternatives, including the no-action alternative. The analysis of each removal action alternative consists of a description of the alternative, followed by an evaluation based on its relative effectiveness, implementability, and estimated cost.

4.5.1 Alternative 1: No Action

Description

This removal action alternative is retained for analysis to provide a basis for comparison with other alternatives. For this alternative, no remedial activities would be implemented at the TSTA Area at NAS Alameda. Table 4-3 provides a detailed evaluation of this alternative.

Table 4-3
Alternative 1: No Action
Detailed Evaluation

EVALUATION CRITERIA		EVALUATION
EFFECTIVENESS	Overall Protection	No action involves no excavation or handling materials. Therefore, site workers require no protective equipment and there is no risk to the community from excavation and transportation of contaminated materials. There are potential potential long term risks for migration of contaminants with deterioration of the cover and rain water collection system
	Compliance with ARARs	Potential ARARs are not met
	Long-term Effectiveness and Permanence	Does not comply with ARARs. Since contaminants are not removed from the soil, future migration of contaminants is likely.
	Reduction in Toxicity, Mobility, or Volume through Treatment	No treatment is involved. Thus, there is no reduction in toxicity, mobility or volume of contaminants at the site.
	System Reliability/Maintainability	No treatment system is required.
IMPLEMENTABILITY	Technical Feasibility	Technically feasible.
	Administrative Feasibility	Not administratively feasible since the alternative is not acceptable to regulatory agencies and is only used for comparative purpose.
	Availability of Services and Materials	No services and materials are required to implement this alternative.
	Regulatory Agency/ Community Acceptance	Acceptance to regulatory agencies is doubtful.
COST	- Engineering - Capital - Operation & Maintenance (O&M)	No Cost has been associated with this alternative.

4.4.2 Alternative 2: Excavation, Soil Washing and/or Solvent Extraction

Description

This alternative consists of soil excavation and on-site soil washing to separate the PCBs and lead and, if necessary, metal solubilization to remove lead from the soil. Surfactant or solvent solutions will be added to PCB- and lead-affected soil. The aqueous phase with high concentrations of the PCBs contaminants is either photolytically treated by UV oxidation or passed through beds of granular activated carbon (GAC) to remove the PCBs. If necessary, the soil will be further acid-washed to solubilize the lead with subsequent precipitation. Precipitated lead is disposed of at a Class I landfill. Figure 4-1 shows the general process for this alternative. Evaluations of the technical feasibility and implementability of this alternative are summarized in Table 4-4.

Excavation

Soils would be excavated and hauled using conventional earthwork equipment such as a backhoe, bulldozers, and trucks. Few obstructions to excavation are likely, since excavation will be shallow (limited to 1 foot bgs). Activities associated with soil excavation include the following:

* Mobilization and Site Preparation. Mobilization consists of all activities associated with mobilizing equipment for Site 16 and preparing staging areas.

  Site preparation activities include removing perforated runway plates, decommissioning utilities, removing necessary portions of site fencing, destroying all monitoring wells located within the excavated area, setting up the on-site soil washing treatment system, and performing the preliminary earthwork necessary for excavation. Site preparation work also includes constructing a temporary chain-link fence, with gates, around the proposed excavation area to prevent unauthorized access to the work area.

* Excavation. The contaminated soil is excavated using a backhoe or other earthwork equipment. Soil is removed from the excavation and temporarily stockpiled on visqeen at an adjacent area. The soil is subsequently transferred to a designated area and stockpiled for on-site soil treatment activities. Excavated concrete or asphalt pavement is stockpiled separately, sampled, analyzed, and disposed of at a concrete recycling or landfill facility.

* Sampling. Verification sampling includes sampling of the excavated area and supplementary EE/CA sampling of the eastern boundary with historically reported high detection-limit PCB data. Screening level sampling will be conducted after the agreed-upon extent of excavation has been attained to assess if additional excavation is required. On completing the excavation, final confirmation sampling will be conducted for verification. The final confirmation samples will assess the residual concentrations in the soil of total petroleum hydrocarbons, PCBs and lead for RI/FS risk assessment purposes. It is assumed that for screening level sampling and final confirmation sampling one sample will be

collected per approximately 2500 square feet of excavation.

* Backfill and Compaction. When the treatment is completed, the excavated area will be backfilled and compacted with the treated soil. All groundwater monitoring wells destroyed prior to excavation will be replaced. After the backfill, compaction, and well installations are completed, the removal action for Site 16 will be complete.

Soil Washing with Surfactant or Solvent Extraction

Soil washing is accomplished by washing the soil with surfactant or solvent to extract the PCBs and lead. Contaminants sorbed onto soil particles are separated from soil in an aqueous-based system. The liquid-PCB containing phase is passed through either a GAC or a UV oxidizer to remove or breakdown the PCB. The liquid surfactant or solvent can be recycled through reflux. The slurry soil phase is either resuspended or treated with acid solution to solubilize the lead. Soluble lead is precipitated chemically and packed in containers for off-site landfill disposal. The remaining slurry suspension is dewatered by centrifugation or filter press. The dewatered soil will be tested for PCBs and lead and confirmed to meet treatment action levels and soluble lead level. Soil containing lead at 130 ppm or less, or PCB at 0.34 ppm, will be stockpiled for replacement on-site.

Figure 4-1

ALTERNATIVE 2
EXCAVATION, SOIL WASHING, PHOTOLYSIS OR GAC ADSORPTION AND METAL SOLUBILIZATION AND ON SITE DISPOSAL

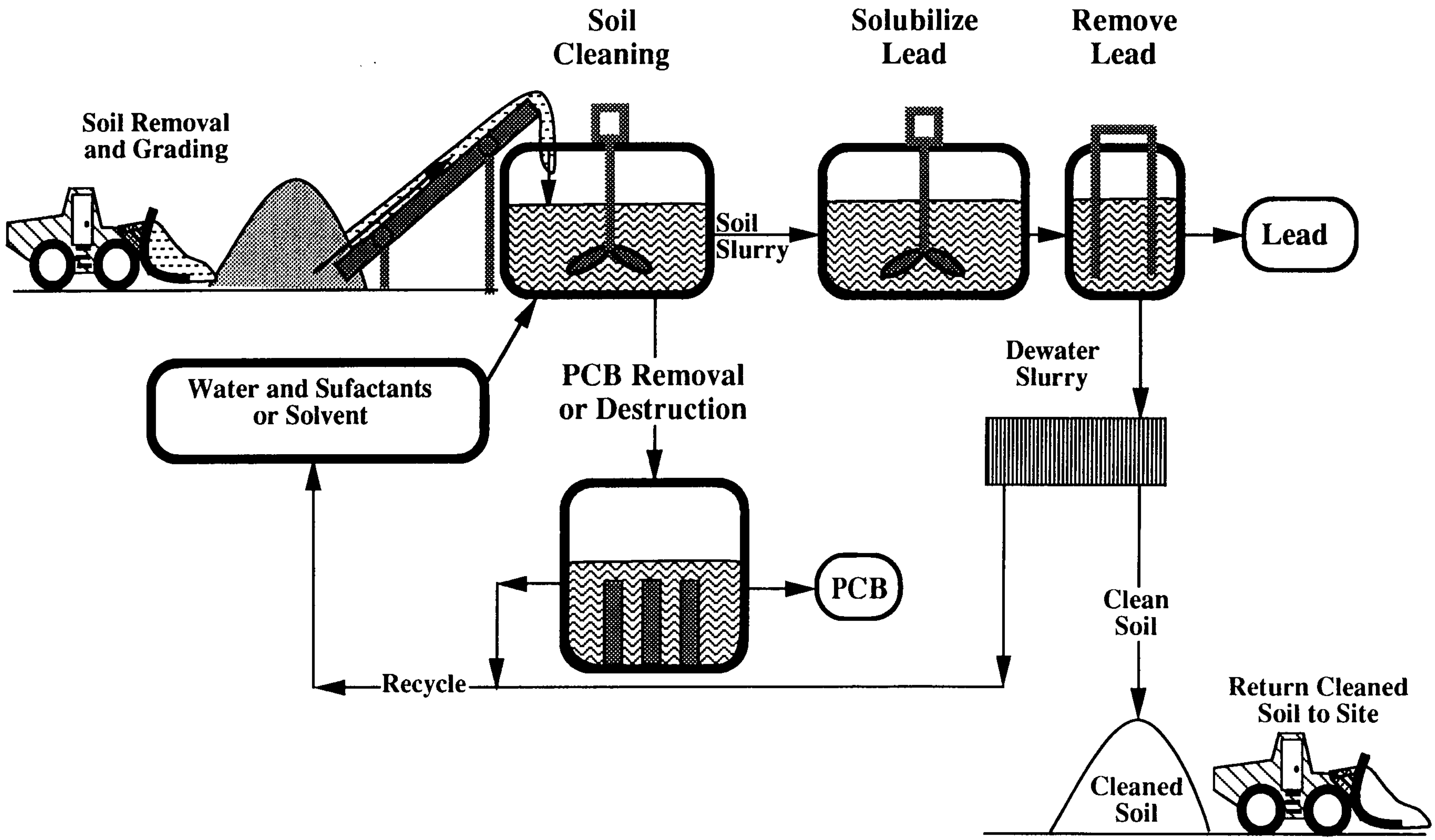


Table 4-4
Alternative 2: Excavation, Soil Washing And/or Solvent Extraction Detailed Evaluation

	EVALUATION CRITERIA	EVALUATION
EFFECTIVENESS	Overall Protection	Soil washing with surfactants or solvent has been proven to reduce PCB levels in soils to 1.0 mg/kg Metal solubilization of lead and subsequent removal by precipitation have also been shown to remove lead. If an appropriate technology for PCB is demonstrated by treatability studies, treating soil will reduce potential adverse impacts to site workers and the public Potential environmental impacts during implementation can be minimized by engineered controls. Excavation poses a potential health and safety risk to site workers through skin contact and air emissions. Personal protective equipment, at a level commensurate with the contaminants involved, is normally required during excavation operations.
	Compliance with ARARs	Potential ARARs are met to the extent practicable if contaminants are reduced to clean-up levels
	Long-term Effectiveness and Permanence	Successful implementation of this alternative provides an adequate degree of protection to both human health and the environment on a long-term basis.
	Reduction in Toxicity, Mobility, or Volume through Treatment	This alternative reduces significantly the total amount of contaminants, the amount of contaminants available to migrate, and the volume of contaminated soil. However, the remaining lead in treated soil may be more soluble, but with less impact due to reduced quantities.
	System Reliability/Maintainability	Prior to implementing this alternative demonstration via treatability studies must be conducted to demonstrate probability of achievement of PCB clean-up levels
IMPLEMENTABILITY	Technical Feasibility	The excavation aspect of this alternative is implementable and site conditions are generally favorable. Soil washing and acid washing are commonly applied technologies that can implemented on-site.
	Administrative Feasibility	Site mobilization and setting up of this alternative may require more space for operation. Permits would be required for discharge and treatment.
	Availability of Services and Materials	Equipment and skilled or knowledgeable personnel required for implementation are available. Personnel specifically trained in soil washing or solvent extraction operations would be required on-site. Water would be required on-site for contamination control (e.g., dust suppression) and treatment activities. Should water not be readily available (e.g., nearby hydrant), water would have to be brought in by truck. Other resources, such as electricity are available on-site, whereas, telephone, and fuel would be provided by mobile sources. Off-site disposal capacity and analytical capabilities are readily available.
	Regulatory Agency/ Community Acceptance	On-site disposal of treated soil is anticipated to be acceptable to the regulatory agencies and the community because this alternative reduces contaminant toxicity, volume, and mobility. In addition, no air emissions are produced using this treatment process.
COST	- Engineering - Capital - Operation & Maintenance (O&M)	$250,000 $1,250,000 $0

4.4.3 Alternative 3: Excavation and Class II Off-Site Disposal

<u>Description</u>
This alternative requires that soil be excavated, transported, and disposed of at an off-site Class II facility. The process for this alternative is as shown in Figure 4-2 Evaluation of the technical feasibility and implementability of this alternative is summarized in Table 4-5.

<u>Excavation</u>
Excavation activities for this alternative are as described in Alternative 2, except that after excavation then transferred to an area designated for loading onto trucks for transport to the off-site disposal facility.

Figure 4-2

ALTERNATIVE 3
EXCAVATION AND CLASS II OFF-SITE DISPOSAL

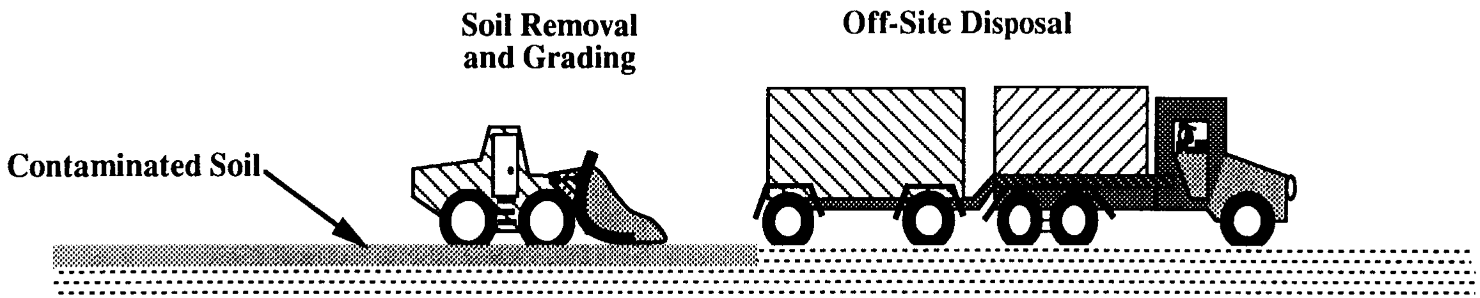


Table 4-5
Alternative 3: Excavation and Class I and II Off-Site Disposal
Detailed Evaluation

EVALUATION CRITERIA		EVALUATION
EFFECTIVENESS	Overall Protection	Removal of contaminants from the site ensures overall protection of both human health and the environment. The contaminated soils are transferred to a managed disposal facility. This alternative meets the basic objectives of overall protection. For workers at the site, personal protective equipment, at a level appropraite for the site conditions will be required.
	Compliance with ARARs	Potential ARARs are met to the extent practicable by removing all contaminated soils which exceed action levels, except for CERCLA preferences against off-site disposal.
	Long-term Effectiveness and Permanence	By moving soil with elevated PCB and lead concentrations from the site to a facility that will physically contain it, the mobility of the contaminants at the site itself is reduced.
	Reduction in Toxicity, Mobility, or Volume through Treatment	The excavation and disposal of subsurface soils does not provide any reduction in the volume of excavated material requiring disposal. Disposal of surface soils in a engineered disposal cell provides reduction in contaminant mobility and eliminates exposure pathways which in turn reduces the potential release of contaminants to the environment.
	System Reliability/Maintainability	System is well established and reliable.
IMPLEMENTABILITY	Technical Feasibility	Excavation and disposal is a well demonstrated removal action which uses standard construction practices. The action is reliable and readily implementable.
	Administrative Feasibility	Permits would not be necessary to implement the action. A traffic management plan for transportation of the soil off-site should be prepared.
	Availability of Services and Materials	Equipment and knowledgeable personnel required for implementation are readily available. Water would be required on-site for contamination control (e.g., dust suppression) and treatment activities. Should water not be readily available (e.g., nearby hydrant), water would have to be brought in by truck. Other resources, such as electricity, telephone, and fuel for equipment would be provided by temporary/mobile sources. Off-site disposal capacity and analytical capabilities are readily available.
	Regulatory Agency/ Community Acceptance	This alternative does not meet the statutory preference for treatment; however, it offers timely mitigation of threats posed by contaminants at the Site 16. This alternative can be accomplished in a short period of time, about 1 month.
COST	- Engineering - Capital - Operation & Maintenance (O&M)	\$50,000 \$550,000 \$0

Class II Off-Site Disposal
Prior to moving soil from Site 16, the soil would have to be sampled and samples subject to laboratory analysis to confirm the non-hazardous classification. Typically this would include collecting one sample for every 50 cubic yards of soil and determining the total concentrations of PCBs and lead, and also the soluble concentrations of these compounds. Based on available data the soil at Site 16 can be disposed of at a Class II land disposal facility. Transportation to the off-site facility requires over 100 trucks, which introduces a potential risk to the community via accidental release.

Backfilling Site Excavation
Clean soil will have to be brought to the site to replace the soil removed from the site.

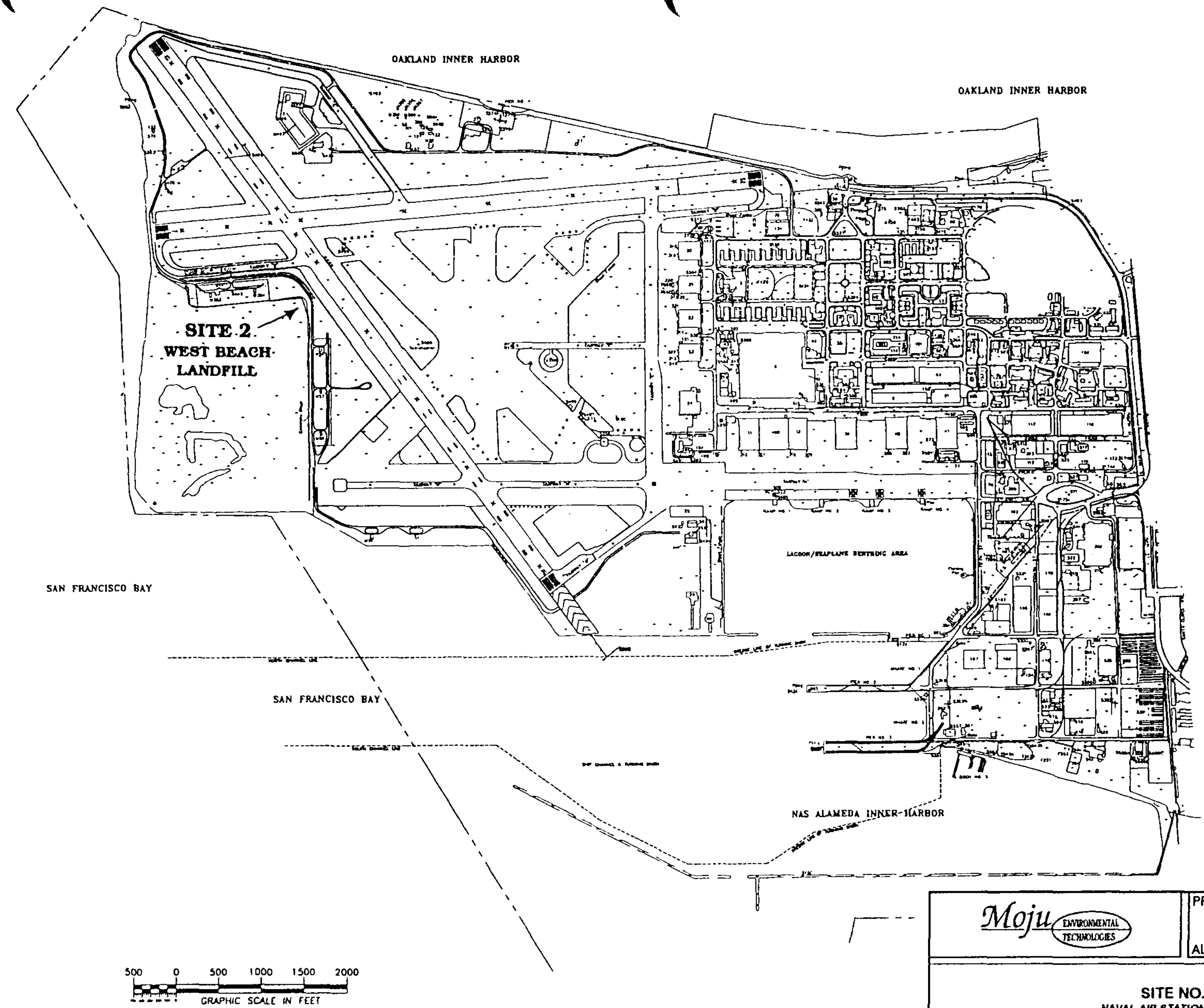
4.5.4 Alternative 4: Disposal at West Beach Landfill

Description

This alternative requires that soil be excavated and transported to the West Beach Landfill (Site 2 NAS Alameda). The soil would be placed in an engineered disposal cell at the West Beach Landfil (Figure 4-3 for this alternative is as shown in Figure 4-4 Evaluation of the technical feasibility and implementability of this alternative is summarized in Table 4-6.

Excavation

Excavation activities for this alternative are as described in Alternative 2, except that after excavation the soil is transferred to an area designated for loading onto trucks for transport to the West Beach Landfill.



Moju Environmental Technologies

PROJECT:
ALAMEDA CALIFORNIA

SITE NO. 16
NAVAL AIR STATION, ALAMEDA
ALAMEDA, CALIFORNIA

WEST BEACH SITE LOCATION

MAY 14, 1997

Figure 4-3

Figure 4-4

ALTERNATE 4
DISPOSAL AT WEST BEACH LANDFILL

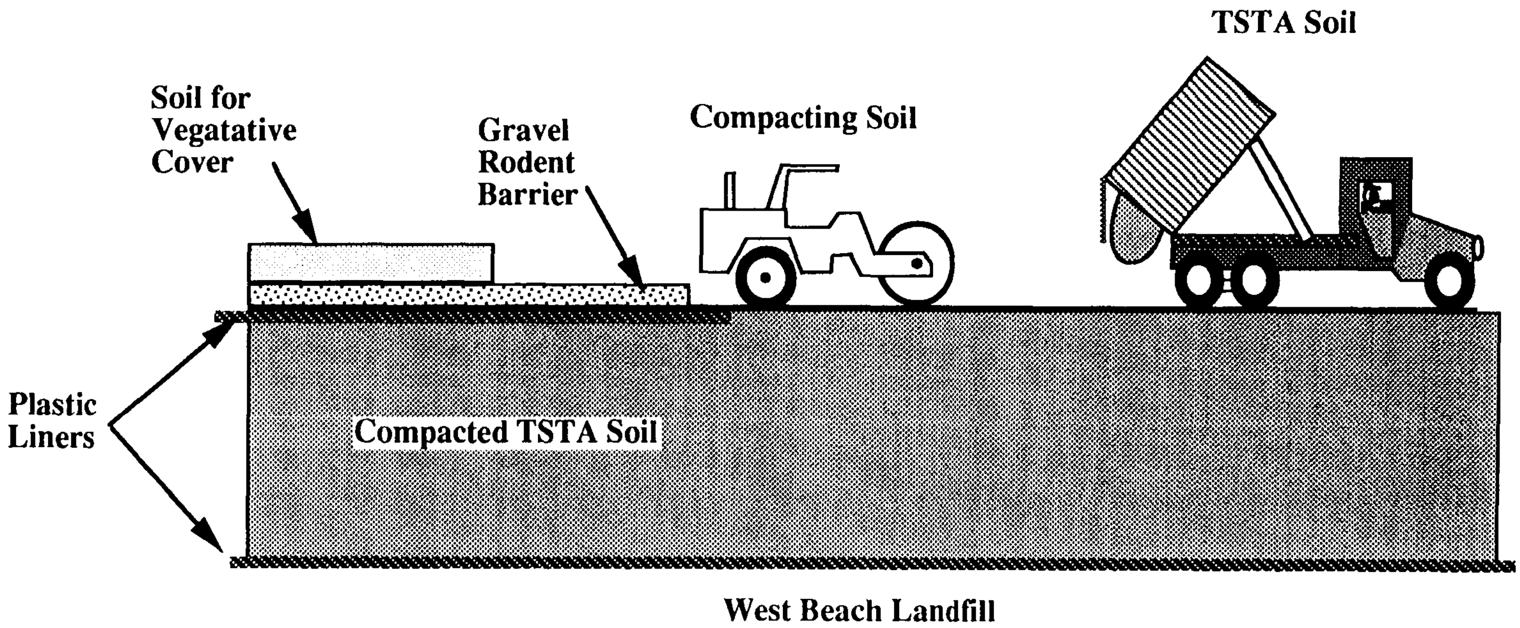


Table 4-6
Alternative 4: Excavation and On-Site Disposal
Detailed Evaluation

	EVALUATION CRITERIA	EVALUATION
EFFECTIVENESS	Overall Protection	Removal of contaminants from the site provides overall protection of both human health and the environment. The contaminated soils are transferred to a engineered disposal fill. This alternative meets the basic objectives of overall protection. Maintenance of the disposal fill would have to be conducted to assure long term protection of health and the environment. For workers at the site, personal protective equipment, at a level appropriate for the site conditions will be required.
	Compliance with ARARs	Potential ARARs are met to the extent practicable by removing all contaminated soils which exceed action levels. Landfill ARARs, for the disposal fill, will have to be complied with.
	Long-term Effectiveness and Permanence	By moving soil with elevated PCB and lead concentrations from the site to a facility that will physically contain it, the mobility of the contaminants is reduced. Catastrophic events, such as an earthquake, could increase the possibility of mobility.
	Reduction in Toxicity, Mobility, or Volume through Treatment	The excavation and disposal of subsurface soils does not provide any reduction in the volume of excavated material requiring disposal. Disposal of surface soils in a engineered disposal cell provides reduction in contaminant mobility and eliminates exposure pathways which in turn reduces the potential release of contaminants to the environment.
	System Reliability/Maintainability	System is well established and reliable.
IMPLEMENTABILITY	Technical Feasibility	Excavation and disposal is a well demonstrated removal action which uses standard construction practices. The action is reliable and readily implementable.
	Administrative Feasibility	Permits would not be necessary to implement the action. Preparation and implementation of Closure, Post Closure, and Closure Certifiction workplans and work would be required.
	Availability of Services and Materials	Equipment and knowledgeable personnel required for implementation are readily available. Water would be required on-site for contamination control (e.g., dust suppression) and treatment activities. Should water not be readily available (e.g., nearby hydrant), water would have to be brought in by truck. Other resources, such as electricity, telephone, and fuel for equipment would be provided by temporary/mobile sources. Off-site disposal capacity for the small amount of soil classified as hazardous waste is available.
	Regulatory Agency/ Community Acceptance	This alternative does not meet the statutory preference for treatment; however, it offers timely mitigation of threats posed by contaminants at the Site 16. This alternative can be accomplished in a short period of time; 2 months with 10 years of maintanence.
COST	- Engineering - Capital - Operation & Maintenance (O&M)	$160,000 $310,000 $250,000 - $400,000 (10 years)

Backfilling Site Excavation

Clean soil will have to be brought to the site to replace the soil removed from the site.

Construction of Engineered Fill at West Beach Landfill

Prior to moving soil from Site 16, the soil would have to be sampled and samples subject to laboratory analysis to confirm the non-hazardous classification. Typically this would include collecting one sample for every 50 cubic yards of soil and determining the total concentrations of PCBs and lead, and also the soluble concentrations of these compounds.

The West Beach Landfill encompasses an area of about 200 acres. The fill would be placed in an area of about 1 acre, at the northeast corner of the landfill, the corner furthest from the San Francisco Bay and the designated wetland area within the West Beach Landfill, as shown in Figure 4-3. The northeast corner is physically isolated from the rest of the landfill by a 10 foot high, 30 foot wide, berm. The fill would reach a height approximately half way to the top of the existing berm of about 10 feet, at the berm, and would slope gently away from the berm to the facility boundaries at the north-west corner of Site 2. At about a distance of 30 to 40 feet from the facility boundary the fill would end at a height of about 2 feet and the slope down to meet the existing grade. The landfill would be constructed at the location shown on Figure 4-3.

In order to construct the fill, geotechnical investigation would have to be conducted to determine if adverse geotechnical conditions are present at the site. The engineered fill will have to be designed to minimize contaminant migration by physical forces such as wind or erosion or by biological activity such as burrowing animals, insects or worms. Additionally , the design will have to provide surety that the integrity of the fill will maintained, to the extent feasable, during catastrophic events such as earthquakes.

Initially, the site will be graded for placement of an impermeable liner at the base of the fill. Soil, from the TSTA, will be placed on the liner and compacted to produce a dense engineered fill. After placing all the TSTA soil, a rodent/insect/worm barrier will be placed on top of TSTA soil, and will surround the entire TSTA fill. Soil capable of supporting a vegetative cover will be placed on top of, and around the perimeter of,the barrier layer and TSTA fill.

5.0 COMPARATIVE ANALYSIS OF REMOVAL ACTION ALTERNATIVES

This section presents a comparative analysis of the four alternatives using the criteria employed in Section 4. Based on this analysis, the four alternatives are ranked in order of preference. Table 5-1 summarizes the comparative analysis of the four removal action alternatives. Details of the comparative analysis are discussed below.

Effectiveness, Implementability, and Cost

The four alternatives were compared and the primary reasons for rejecting a removal action are described below and shown in Table 5-1.

Alternative 1 (No Action) does not provide adequate short-term or long-term effectiveness or permanence for Site 16 soil because contaminants are not removed and the cover and rain water collection system are not maintained. The likelihood of community and regulatory acceptance of this alternative is low. Therefore, the No Action alternative is eliminated.

The effectiveness of Alternative 2 (On-site Treatment), especially for PCBs is difficult to ascertain. Treatability studies would have to be conducted initially with no assurance that an acceptable technology for the site soils could be found. Thus, on-site treatment may not provide sufficient assurance of adequate long-term environmental and public health protection. Additionally, the cost of treatment technologies (including treatability studies) is very expensive as it is a two step process; one step for removal of PCBs and a second step for removal of lead. For these two reasons Alternative 2 is eliminated.

Implementation of Alternative 3 (Off-site Landfill Disposal) would remove the affected soil from the site and from the facility and therefore is permanently effective for the NAS Alameda Facility. The initial cost of this alterative is similar to Alterative 4, but upon completion of the project there are no foreseeable additional costs. This alternative is the preferred alternative.

Alternative 4 (On-site Disposal) has a similar initial cost to off-site disposal, and is probably as effective as off-site disposal. However, in the event of a major earthquake the level protection provided by on-site disposal may be substantially reduced. Alternative 4 requires preparation of a Closure, Post Closure and Certification of Closure Workplans and completing work tasks as specified in those workplans. The work includes long term monitoring and maintenance. Also, Alternative 4 is likely to have long-term implications to the closure of the West Beach Landfill. Alternative 4 is likely to take longer to implement due to the need for engineering studies and for regulatory approval and has a higher overall cost with operations and maintenance included.

Table 5 - 1

REMEDIAL ALTERNATIVES COMPARISON SUMMARY
SITE 16 - CANS - 2 AREA

Remedial Alternative	Effectiveness	Implementability	Estimated Total Capital Cost
Alternative 1 Excavation, Storage, and Treatment at TSTA	Provides adequate protection to human health and the environment. Removal action objectives are likely to be achieved with this alternative. PCBs and lead are removed from soil. The Site is avaliable for reuse as soon as excavation work is completed.	Technically and administratively implementable. On-site treatment would require permitting. A treatability study would assess effectiveness. Treatment work requires secondary treatment or disposal. Regulatory and community acceptance of on-site disposal will be required. Backfill of acid-washed soil would be treated.	
Alternative 2 Excavation, Soil Washing, and/or Solvent Extraction	Provides adequate protection to human health and the environment. Removal action objectives are likely to be achieved with this alternative. PCBs and lead are removed from soil. Therefore, treated soil disposal on site should not affect the groundwater over the long term.	Technically and administratively implementable. On-site soil washing, photolysis and acid washing would require permitting. A treatability study would assess effectiveness. Treatment work requires secondary treatment or disposal. Regulatory and community acceptance of on-site disposal will be required. Backfill of acid-washed soil would be treated.	$1,200,000
Alternative 3 Excavation, Slurry-phase Bioremediation, and Acid Washing	Provides adequate protection to human health and the environment. Removal action objective are likely to be achieved with this alternative. However Bio-slurry remediation may not be effective for removing PCBs. Treated soil is backfilled may affect the groundwater over a long period of time.	May be relatively difficult to implement. On-site bioremediation would require permitting. Effectiveness of treatment requires verification by treatability study. By-products may require secondary treatment or disposal. Regulatory and community acceptance of on-site disposal may be difficult.	$1,020,000
Alternative 4 Soil Capping with Asphalt (No Excavation)	Provides inadequate protection to human health and the environment. Removal action objectives are not achieved with this alternative. Because soils would not be permanently removed from the site, this alternative is highly ineffective in eliminating long term impacts to groundwater.	Technically but not administratively implementable (that is, public and regulatory agency acceptance may be difficult). Does not remove liability associated with land reuse. Restricted future land use.	$380,000
Alternative 5 Excavation and Class I and II Off-Site Disposal	Provides adequate protection to human health and the environment. Removal action objectives are achieved with this alternative. Because soils would be permanently removed from the site, this alternative is highly effective in eliminating impacts to groundwater. Off-site disposal is, however, a least preferred remedial alternative.	Implementable. Facility treatability study required to determine if pretreatment is necessary. Class I disposal facility likely to accept and dispose of waste with or without pretreatment in accordance with federal and state land LDRs. Class II disposal facility would accept waste on a case-by-case basis. Long-term liability at landfill.	$720,000 (without treatment)
Alternative 6 In-Situ Solidification or Stabilization (Fixation)	Provides moderate protection to human health and the environment. Removal action objectives are likely to be achieved with this alternative. PCBs and lead monitoring long term is required. Treated soil may affect groundwater long term.	Implementable. In-Situ immobilization would require permitting. Effectiveness of treatment requires verification by leachability study. Regulatory and community acceptance may be difficult.	$790,000
Alternative 7 No Action	Inadequate protection to human health and the environment. Removal action objectives are not attained with this alternative. Contaminants will remain on site. Natural bioremediation process results in little or no remediation over a long period of time.	Technically but not administratively implementable (that is, public and regulatory agency acceptance may be difficult). Does not remove liability associated with land reuse.	No Cost

Date: 11/06/95

6.0 RECOMMENDED REMOVAL ACTION ALTERNATIVE

The recommended removal action is determined primarily by the analysis of the alternatives using the evaluation criteria indicated in Section 5. The alternative that most satisfies the effectiveness and implementability criteria is identified as the preferred alternative. However, the preferred removal action must also satisfy the site-specific removal objectives at Site 16 which include an unrestricted future use of the site.

Alternative 3 (Excavation, and Off-site Diposal) is the preferred alternative. This alternative mitigates the risk to human health and the environment and reduces the potential impacts of soil contaminants on the environment. None of the other alternatives provide the surety of long term effectiveness that Alternitive 3 provides. The overall costs of the other alternatives, except No Action, are greater.

7.0 REFERENCES

40 CFR Part 300. 1990. National Oil and Hazardous Substances Pollution Contingency Plan. U.S. Code of Federal Regulations.

40 CFR Parts 300-375. 1993. Superfund, Emergency Planning, and Community Right-To-Know Programs. U.S. Code of Federal Regulations.

Comprehensive Environmental Response, Compensation, Liability Act of 1980 (CERCLA), Public Law 96-51

CERCLA Compliance with Other Laws Manual: Interim Final. 1988. EPA/540/G-89/006.

CERCLA Compliance with Other Laws Manual: Part II. Clean Air Act and Other Environmental Statutes and State Requirements. 1991. EPA/540/G-89/009.

Superfund Removal Procedures: Guidance on the Consideration of ARARs During Removal Actions. 1991. EPA/540/P-91/011.

Superfund Removal Procedures: Public Participation Guidance for On-Scene Coordinators - Community Relations and the Administrative Record. 1992. OERR Publication 9360.3-05.

Guidance on Conducting Non-Time Critical Removal Actions Under CERCLA. 1993. OSWER Publication 9360.0-32.

Community Relations in Superfund: A Handbook. 1992. OERR Directive 9230.0-03C

Navy/Marine Corps Installation Restoration Manual. 1992.

Environmental and Natural Resources Program Manual, OPNAVINST 5090.1A or Environmental Compliance and Protection Manual, MCO P5090.2.

Canonie Environmental (Canonie). 1990. "Sampling Plan, Remedial Investigation/Feasibility Study Naval Air Station Alameda, California, Volume I." Prepared for Navy-WESTDIV. February 12.

Department of Toxic Substances Control (DTSC). 1994. "Preliminary Endangerment Assessment Guidance Manual, Final." State of California Environmental Protection Agency. January.

Ecology and Environment, Inc. (E&E). 1983. "Initial Assessment of Naval Air Station, Alameda, California." Prepared for Naval Energy and Environmental Support Activity (NEESA), Document Number 13-014. April.

McCoy and Associates, Inc. 1992. "Polychlorinated Biphenols (PCBs) - Regulations and Treatment Technologies." *The Hazardous Waste Consultant.* Volume 10, Issue 3. May/June.

National Oil and Hazardous Substances Pollution Contingency Plan (NCP). 1992. 40 CFR Part 300. Office of the Federal Register. Revised July 1.

PRC Environmental Management, Inc. (PRC) and James M. Montgomery, Consulting Engineers, Inc. (JMM). 1992. "Data Summary Report RI/FS Phases 2B and 3, Volume 1 of 2, Naval Air Station Alameda, Alameda, California (Final)." Prepared for Navy-WESTDIV. October 27.

PRC and Montgomery Watson. 1994. "Removal Action, Site 15 Buildings 301 and 389, Transformer Storage Area, Field Investigation Work Plan (Final)." Prepared for Navy-WESTDIV. March 28.

U.S. Environmental Protection Agency (USEPA). 1987. "Remedial Action Costing Procedure Manual." Contract No. 68-03-3113. USEPA 600/8-87/049. October.

USEPA. 1990. "Guidance on Remedial Actions for Superfund Sites with PCB Contamination." Office of Emergency Response and Remedial Response, USEPA 540/G-90/007, Washington, D.C. August.

Wahler Associates (Wahler). 1985. "Draft Report, Verification Step, Confirmation Study." Prepared for Western Division Naval Facilities Engineering Command. May.

Weamer, Lanee. 1994. Personal Communication to Jeff Liu of Montgomery Watson, Lanee Weamer, Resources Conservation Company, Maryland, February 7.

U.S. Environmental Protection Agency, Hazardous Waste Engineering Research Laboratory, 1989. Standard Handbook of Hazardous Waste Treatment and Disposal. Harry M. Freeman, Editor. Published by McGraw-Hill Book Company.

Department of Health Services, Toxic Substances Control Division, Alternative Technology and Policy Development Section. 1986. Alternative Technology for Recycling and Treatment of Hazardous Wastes, the Third Biennial Report.

Institute of Gas Technology. Technology Spotlight: Manufactured Gas Plant Site Remediation (Slurry Phase).

EPA. 1993. Remediation Technologies Screening Matrix and Reference Guide.

Senate Bill No. 1706 introduced by Senator Wright, February 24, 1984.

USEPA Region IX letter from Stanford J. Smucker, PH.D. to PRG Table Mailing List titled "Region IX Preliminary Remediation Goals (PRGs) First Half 1995," dated February 1, 1995.

APPENDIX A

SUMMARY OF APPENDIX A

Appendix A contains the following four sections:

Section 1: Figure A1 - Map of Sample Locations at Site 16, NAS Alameda from Canonie and PRC Investigations.

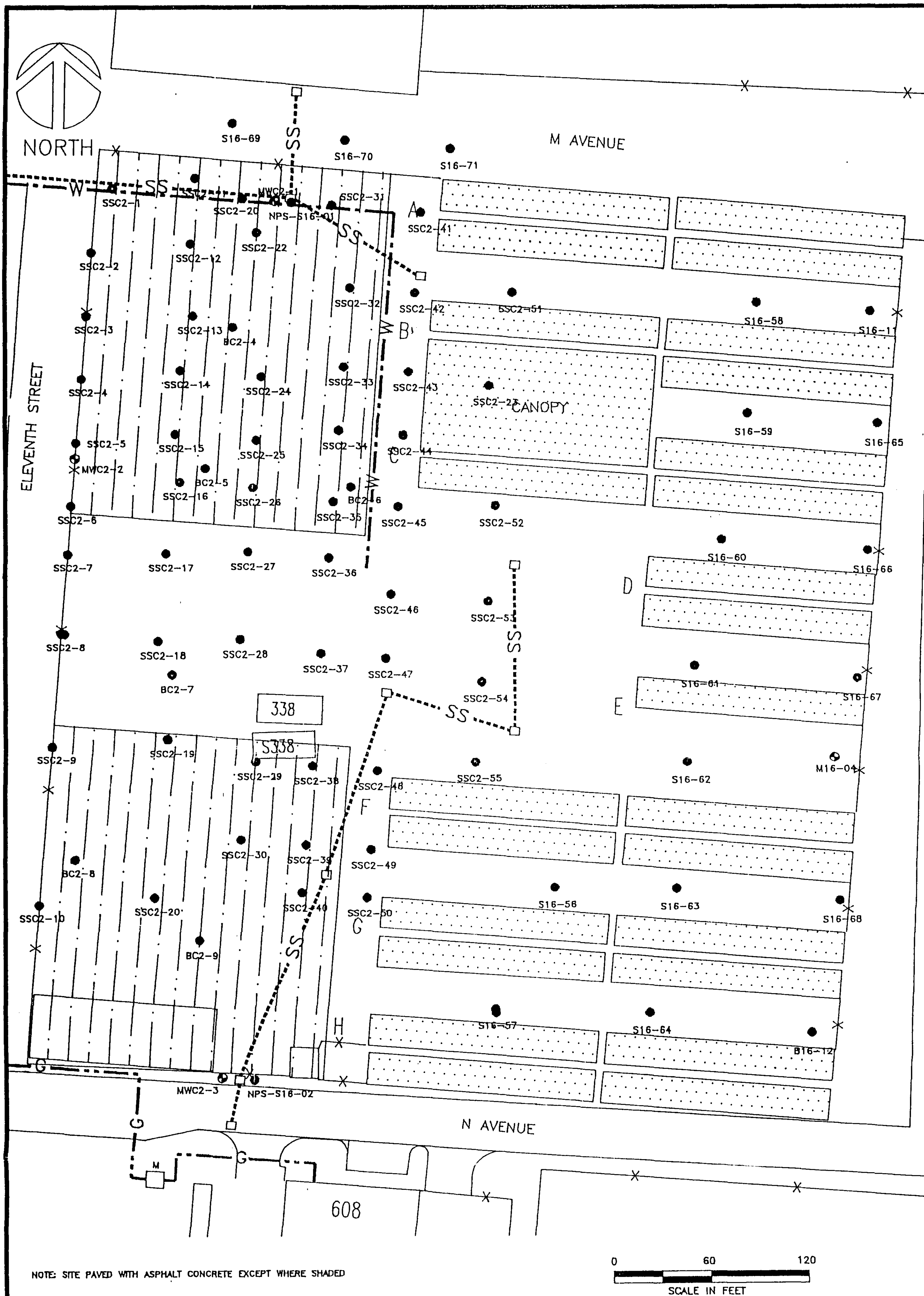
Section 2: Compiled analytical data of PCBs in soil samples from Site 16 and charts illustrating the distributions of PCB concentrations. Analytical data from a total of 135 samples are included, 101 samples from the Canonie investigation and 34 samples from the PRC investigation.

The X, Y, and Z values in the analytical data tables represent the locations of the soil samples. The X and Y values are horizontal distances from the southwest corner of Site 16 (intersection of Eleventh Street and N Avenue) measured in feet. X values are measured in the east direction parallel to N Avenue. Y values are measured in the north direction parallel to Eleventh Street. The Z values are distances below ground surface measured in feet.

Section 3: Compiled analytical data of Lead in soil samples from Site 16 and charts illustrating the distributions of Lead. The number of samples included in the data is the same number as Section 2, above. The X, Y, and Z values are measured in the same manner as described in Section 2.

Section 4: Compilation of Historical Analytical Data, Site 16 - Canonie and PRC Investigations. The data includes all of the analytical results collected at various locations and depths. It also includes all the analytes listed by each EPA method. The data are organized as follows: sample ID (sample depth), sample matrix, analyte type, chemical name of the analyte, laboratory reporting limit, reporting unit, laboratory qualifier, and analytical method.

APPENDIX A
- Section 1



NOTE: SITE PAVED WITH ASPHALT CONCRETE EXCEPT WHERE SHADED

LEGEND

[symbol]	STEEL PLATES ON GROUND SURFACE	--SS--	STORM SEWER LINE
[symbol]	CANS BUILDINGS	—G—	NATURAL GAS LINE
● S16-71	SOIL SAMPLE LOCATION	—W—	FIRE PROTECTION WATER LINE
● MWC2-3	MONITORING WELL LOCATION		

SOURCE: PRC SITE PLAN, FIGURE 8-1, UNDATED, SCALE 1"=115'

Mofu EARTH TECH

PROJECT: 955733.01

ALAMEDA CALIFORNIA

SITE 16
NAS ALAMEDA

SAMPLE LOCATIONS

JULY 1995

FIGURE A1

APPENDIX A
- Section 2

Site - 16

PCBs in Soil Samples

X	Y	Z	Sample #	Units = ppm Aroclor-1248	Aroclor-1254	Aroclor-1260	Total PCBs* (ppm)	Total PCBs** (ppm)	Total PCBs*** (ppm)
250	445	0.5	SSC2-23	-2.500	23.000	-5.000	30.500	26.750	26.750
110	275	0.5	SSC2-28	-1.300	19.000	-2.500	22.800	20.900	20.900
160	120	0.5	SSC2-40	-2.500	-5.000	-5.000	12.500	0.625	0.250
145	550	0.5	SSC2-31	-0.250	-0.500	7.300	8.050	7.675	7.675
110	440	0.5	SSC2-24	4.600	-0.500	-0.500	5.600	5.100	5.100
200	270	0.5	SSC2-47	-1.100	-2.100	-2.100	5.300	0.625	0.250
200	200	0.5	SSC2-48	-1.100	-2.100	-2.100	5.300	0.625	0.250
200	150	0.5	SSC2-49	-1.100	-2.100	-2.100	5.300	0.625	0.250
200	120	0.5	SSC2-50	-1.100	-2.100	-2.100	5.300	0.625	0.250
260	370	0.5	SSC2-52	-1.100	-2.100	-2.100	5.300	0.625	0.250
260	260	0.5	SSC2-54	-1.100	-2.100	-2.100	5.300	0.625	0.250
260	210	0.5	SSC2-55	-1.100	-2.100	-2.100	5.300	0.625	0.250
200	500	0.5	SSC2-42	-1.000	-2.100	-2.100	5.200	0.625	0.250
200	450	0.5	SSC2-43	-1.000	-2.100	-2.100	5.200	0.625	0.250
260	310	0.5	SSC2-53	-1.000	-2.100	-2.100	5.200	0.625	0.250
200	410	0.5	SSC2-44	-1.000	-2.000	-2.000	5.000	0.625	0.250
200	365	0.5	SSC2-45	-1.000	-2.000	-2.000	5.000	0.625	0.250
260	505	0.5	SSC2-51	-1.000	-2.000	-2.000	5.000	0.625	0.250
160	500	0.5	SSC2-32	-0.120	-0.250	4.000	4.370	4.185	4.185
100	530	0.5	SSC2-22	-0.250	-0.500	3.500	4.250	3.875	3.875
60	520	0.5	SSC2-12	-0.500	-1.000	2.300	3.800	3.050	3.050
60	560	0.5	SSC2-11	-0.500	-1.000	-1.000	2.500	0.625	0.250
65	475	0.5	SSC2-13	-0.250	-0.500	1.600	2.350	1.975	1.975
90	550	0.5	SSC2-21	-0.250	-0.500	1.500	2.250	1.875	1.875
160	450	0.5	SSC2-33	-0.260	-0.530	-0.530	1.320	0.625	0.250
120	550	0.0	NPS-S16-01	-0.430	-0.430	-0.430	1.290	0.625	0.250
10	550	0.5	SSC2-1	-0.250	-0.500	-0.500	1.250	0.625	0.250
60	440	0.5	SSC2-14	-0.250	-0.500	-0.500	1.250	0.625	0.250
60	400	0.5	SSC2-15	-0.250	-0.500	-0.500	1.250	0.625	0.250
0	510	0.5	SSC2-2	-0.250	-0.500	-0.500	1.250	0.625	0.250
70	110	0.5	SSC2-20	-0.250	-0.500	-0.500	1.250	0.625	0.250
110	400	0.5	SSC2-25	-0.250	-0.500	-0.500	1.250	0.625	0.250
110	370	0.5	SSC2-26	-0.250	-0.500	-0.500	1.250	0.625	0.250
125	200	0.5	SSC2-29	-0.250	-0.500	-0.500	1.250	0.625	0.250
0	470	0.5	SSC2-3	-0.250	-0.500	-0.500	1.250	0.625	0.250
120	150	0.5	SSC2-30	-0.250	-0.500	-0.500	1.250	0.625	0.250
160	410	0.5	SSC2-34	-0.250	-0.500	-0.500	1.250	0.625	0.250
160	365	0.5	SSC2-35	-0.250	-0.500	-0.500	1.250	0.625	0.250
160	330	0.5	SSC2-36	-0.250	-0.500	-0.500	1.250	0.625	0.250
160	270	0.5	SSC2-37	-0.250	-0.500	-0.500	1.250	0.625	0.250
160	200	0.5	SSC2-38	-0.250	-0.500	-0.500	1.250	0.625	0.250
160	150	0.5	SSC2-39	-0.250	-0.500	-0.500	1.250	0.625	0.250
0	430	0.5	SSC2-4	-0.250	-0.500	-0.500	1.250	0.625	0.250
0	350	0.5	SSC2-6	-0.250	-0.500	-0.500	1.250	0.625	0.250
0	320	0.5	SSC2-7	-0.250	-0.500	-0.500	1.250	0.625	0.250
0	200	0.5	SSC2-9	-0.250	-0.500	-0.500	1.250	0.625	0.250
140	0	0.0	NPS-S16-02DUP	-0.230	-0.230	0.570	1.030	0.800	0.800
110	550	11.5	MWC2-1	-0.200	-0.410	-0.410	1.020	0.510	0.250
140	0	0.0	NPS-S16-02	-0.210	-0.210	0.390	0.810	0.600	0.600
170	375	14.5	BC2-6	-0.160	-0.310	-0.310	0.780	0.390	0.250
0	100	0.5	SSC2-10	-0.150	-0.290	-0.290	0.730	0.365	0.250
120	0	1.5	MWC2-3	-0.130	-0.270	-0.270	0.670	0.335	0.250
65	370	0.5	SSC2-16	-0.130	-0.250	-0.250	0.630	0.315	0.250
60	325	0.5	SSC2-17	-0.130	-0.250	-0.250	0.630	0.315	0.250
110	330	0.5	SSC2-27	-0.130	-0.250	-0.250	0.630	0.315	0.250
0	390	0.5	SSC2-5	-0.130	-0.250	-0.250	0.630	0.315	0.250

X	Y	Z	Sample #	Units = ppm Aroclor-1248	Aroclor-1254	Aroclor-1260	Total PCBs* (ppm)	Total PCBs** (ppm)	Total PCBs*** (ppm)
0	270	0.5	SSC2-8	-0.125	-0.250	-0.250	0.625	0.313	0.250
60	270	0.5	SSC2-18	-0.120	-0.250	-0.250	0.620	0.310	0.250
70	210	0.5	SSC2-19	-0.120	-0.250	-0.250	0.620	0.310	0.250
200	550	0.5	SSC2-41	-0.100	-0.200	-0.200	0.500	0.250	0.250
200	310	0.5	SSC2-46	-0.100	-0.200	-0.200	0.500	0.250	0.250
110	550	13.0	MWC2-1	-0.034	-0.067	-0.067	0.168	0.084	0.084
0	380	9.5	MWC2-2	0.032	-0.065	-0.065	**0.162**	**0.097**	**0.097**
120	0	10.5	MWC2-3	-0.032	-0.065	-0.065	0.162	0.081	0.081
0	380	15.0	MWC2-2	-0.032	-0.064	-0.064	0.160	0.080	0.080
0	380	12.5	MWC2-2	-0.032	-0.063	-0.063	0.158	0.079	0.079
120	0	13.0	MWC2-3	-0.032	-0.063	-0.063	0.158	0.079	0.079
120	0	7.5	MWC2-3	-0.031	-0.063	-0.063	0.157	0.079	0.079
100	85	6.0	BC2-9	-0.031	-0.062	-0.062	0.155	0.078	0.078
80	380	7.5	BC2-5	-0.031	-0.062	-0.062	0.155	0.078	0.078
120	0	9.0	MWC2-3	-0.031	-0.062	-0.062	0.155	0.078	0.078
90	470	10.0	BC2-4	-0.031	-0.062	-0.062	0.155	0.078	0.078
70	250	10.0	BC2-7	-0.031	-0.062	-0.062	0.155	0.078	0.078
100	85	14.5	BC2-9	-0.031	-0.062	-0.062	0.155	0.078	0.078
70	250	5.5	BC2-7	-0.031	-0.061	-0.061	0.153	0.077	0.077
20	130	5.5	BC2-8	-0.031	-0.061	-0.061	0.153	0.077	0.077
110	550	6.0	MWC2-1	-0.031	-0.061	-0.061	0.153	0.077	0.077
20	130	10.0	BC2-8	-0.031	-0.061	-0.061	0.153	0.077	0.077
100	85	10.0	BC2-9	-0.031	-0.061	-0.061	0.153	0.077	0.077
90	470	13.5	BC2-4	-0.031	-0.061	-0.061	0.153	0.077	0.077
20	130	15.0	BC2-8	-0.031	-0.061	-0.061	0.153	0.077	0.077
110	550	9.0	MWC2-1	-0.030	-0.061	-0.061	0.152	0.076	0.076
80	380	14.0	BC2-5	-0.030	-0.061	-0.061	0.152	0.076	0.076
170	375	5.5	BC2-6	-0.030	-0.060	-0.060	0.150	0.075	0.075
120	0	5.5	MWC2-3	-0.030	-0.060	-0.060	0.150	0.075	0.075
0	380	6.5	MWC2-2	-0.030	-0.060	-0.060	0.150	0.075	0.075
170	375	10.0	BC2-6	-0.030	-0.059	-0.059	0.148	0.074	0.074
70	250	14.5	BC2-7	-0.030	-0.059	-0.059	0.148	0.074	0.074
70	250	1.0	BC2-7	-0.029	-0.058	-0.058	0.145	0.073	0.073
80	380	1.5	BC2-5R	-0.029	-0.058	-0.058	0.145	0.073	0.073
170	375	1.5	BC2-6R	-0.028	-0.056	-0.056	0.140	0.070	0.070
80	380	1.0	BC2-5	-0.027	-0.054	-0.054	0.135	0.068	0.068
0	380	1.5	MWC2-2	-0.026	-0.053	-0.053	0.132	0.066	0.066
170	375	1.0	BC2-6	-0.026	-0.052	-0.052	0.130	0.065	0.065
20	130	1.0	BC2-8	-0.026	-0.052	-0.052	0.130	0.065	0.065
20	130	1.5	BC2-8R	-0.026	-0.052	-0.052	0.130	0.065	0.065
110	550	1.5	MWC2-1R	-0.026	-0.052	-0.052	0.130	0.065	0.065
110	550	3.0	MWC2-1	-0.026	-0.052	-0.052	0.130	0.065	0.065
0	380	3.5	MWC2-2	-0.026	-0.052	-0.052	0.130	0.065	0.065
90	470	1.0	BC2-4	-0.026	-0.051	-0.051	0.128	0.064	0.064
100	85	1.0	BC2-9	-0.026	-0.051	-0.051	0.128	0.064	0.064
110	550	1.0	MWC2-1	-0.026	-0.051	-0.051	0.128	0.064	0.064
90	470	5.5	BC2-4	-0.026	-0.051	-0.051	0.128	0.064	0.064
150	590	0.0	S16-70	-0.042	-0.042	0.038	**0.122**	**0.080**	**0.080**
480	55	0.0	B16-12-0	-0.040	-0.040	-0.040	0.120	0.060	0.060
480	55	5.0	B16-12-5.0	-0.040	-0.040	-0.040	0.120	0.060	0.060
15	495	2.5	B16-10-2.5	-0.039	-0.039	-0.039	0.117	0.059	0.059
15	495	5.0	B16-10-5.0	-0.039	-0.039	-0.039	0.117	0.059	0.059
480	510	5.0	B16-11-5.0	-0.039	-0.039	-0.039	0.117	0.059	0.059
480	230	5.0	M16-04-5.0	-0.039	-0.039	-0.039	0.117	0.059	0.059
480	55	2.5	B16-12-2.5	-0.038	-0.038	-0.038	0.114	0.057	0.057
480	230	2.5	M16-04-2.5DUP	-0.038	-0.038	-0.038	0.114	0.057	0.057
15	495	0.0	B16-10-0	-0.037	-0.037	-0.037	0.111	0.056	0.056
480	510	0.0	B16-11-0	-0.037	-0.037	-0.037	0.111	0.056	0.056
480	230	0.0	M16-04-0	-0.035	-0.035	-0.035	0.105	0.053	0.053
80	595	0.0	S16-69	-0.035	-0.035	-0.035	0.105	0.053	0.053
480	230	2.5	M16-04-2.5	-0.035	-0.035	-0.035	0.105	0.053	0.053
410	510	0.0	S16-58	-0.034	-0.034	0.036	**0.104**	**0.070**	**0.070**
315	135	0.0	S16-56	-0.034	-0.034	-0.034	0.102	0.051	0.051
410	440	0.0	S16-59	-0.034	-0.034	-0.034	0.102	0.051	0.051

X	Y	Z	Sample #	Units = ppm Aroclor-1248	Aroclor-1254	Aroclor-1260	Total PCBs* (ppm)	Total PCBs** (ppm)	Total PCBs*** (ppm)
400	360	0.0	S16-60	-0.034	-0.034	-0.034	0.102	0.051	0.051
390	280	0.0	S16-61	-0.034	-0.034	-0.034	0.102	0.051	0.051
390	220	0.0	S16-62	-0.034	-0.034	-0.034	0.102	0.051	0.051
390	140	0.0	S16-63	-0.034	-0.034	-0.034	0.102	0.051	0.051
390	140	0.0	S16-63DUP	-0.034	-0.034	-0.034	0.102	0.051	0.051
490	440	0.0	S16-65	-0.034	-0.034	-0.034	0.102	0.051	0.051
490	360	0.0	S16-66	-0.034	-0.034	-0.034	0.102	0.051	0.051
490	280	0.0	S16-67	-0.034	-0.034	-0.034	0.102	0.051	0.051
215	590	0.0	S16-71	-0.034	-0.034	-0.034	0.102	0.051	0.051
15	495	2.5	B16-10-2.5DUP	-0.034	-0.034	-0.034	0.102	0.051	0.051
480	510	2.5	B16-11-2.5	-0.034	-0.034	-0.034	0.102	0.051	0.051
285	55	0.0	S16-57	-0.034	-0.034	0.029	**0.097**	**0.063**	**0.063**
380	60	0.0	S16-64	-0.033	-0.033	0.030	**0.096**	**0.063**	**0.063**
490	140	0.0	S16-68	-0.034	-0.034	0.026	**0.094**	**0.060**	**0.060**
90	470	10.5	BC2-4R	-0.004	-0.004	-0.004	0.011	0.006	0.006

Note: Canonie - 101 samples, PRC - 34 samples, total of 135 samples.

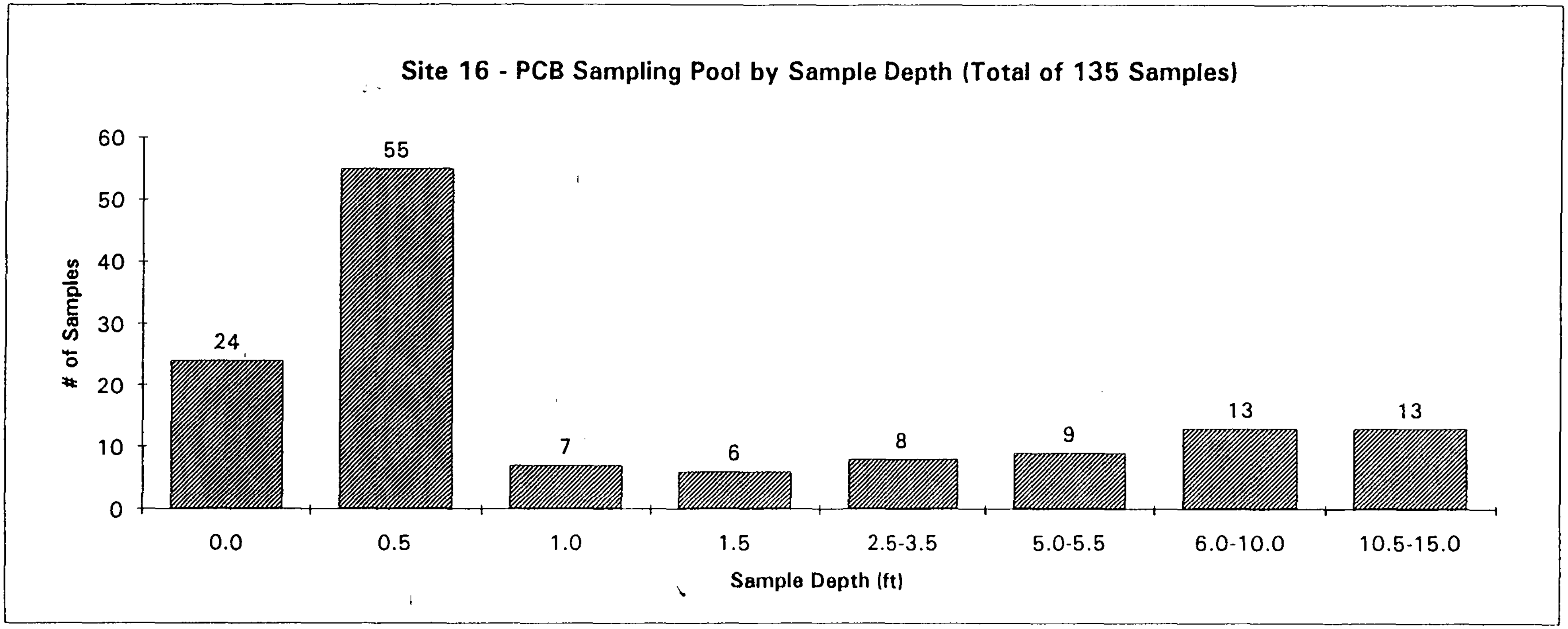
*: Total PCBs was calculated by using actual detection limits to represent samples reported "ND".

*: Total PCBs was calculated by using half of the detection limits with a maximum conc. of 0.625 ppm to represent samples reported "ND".

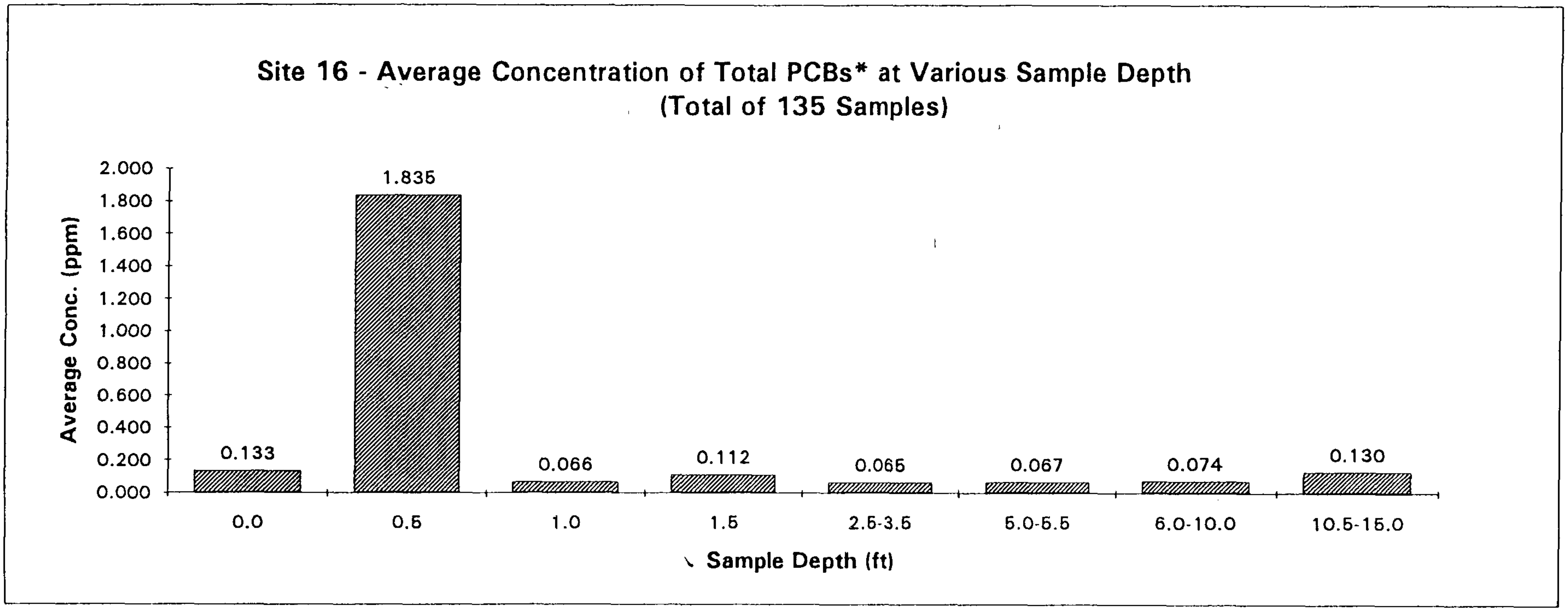
*: Total PCBs was calculated by using half of the detection limits with a maximum conc. of 0.250 ppm to represent samples reported "ND".

"-" = "less than", reported as "ND".

Sample with the highest concentration of Total PCBs.

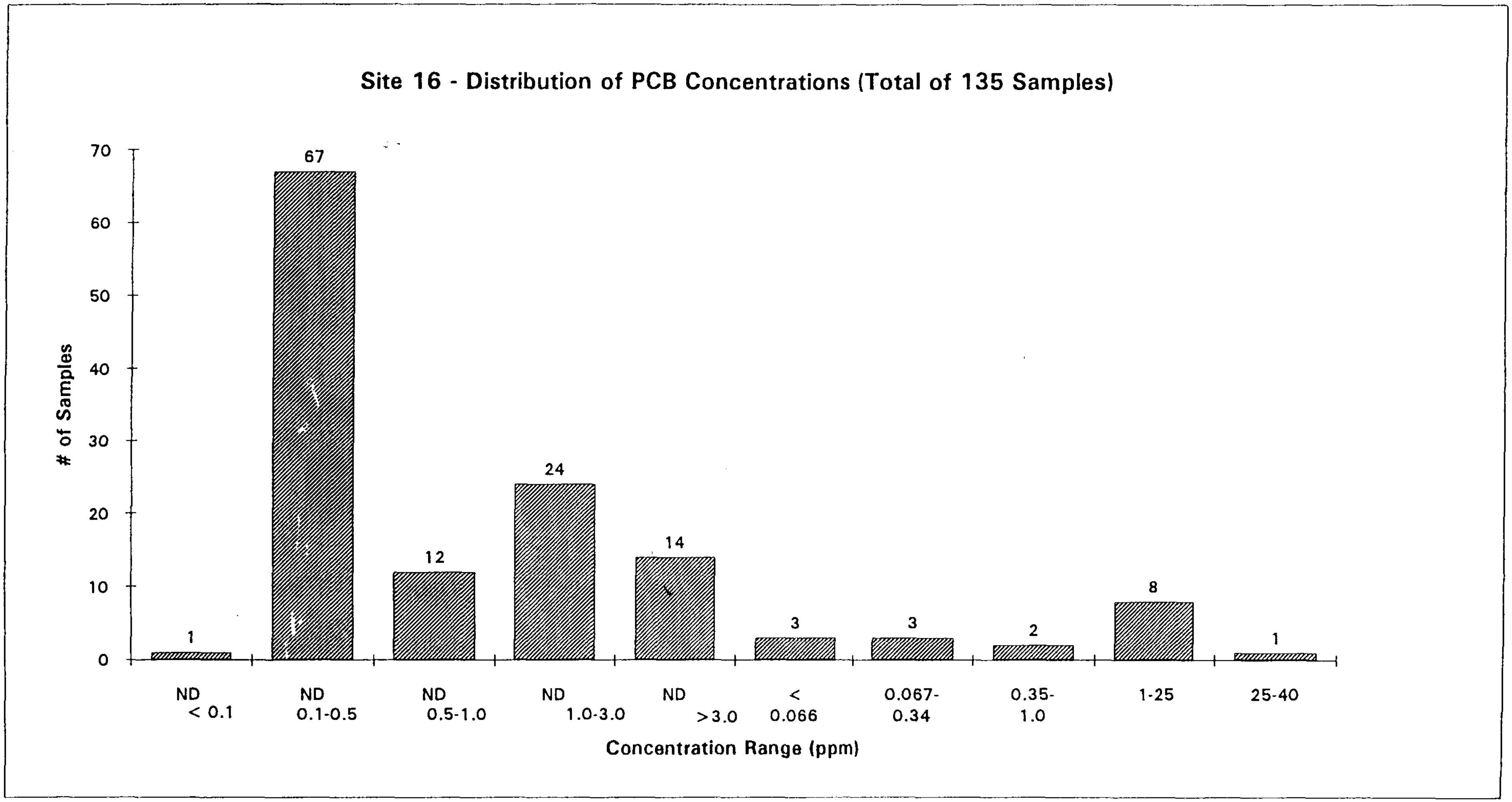

Site 16 - PCB Sampling Pool by Sample Depth (Total of 135 Samples)
# of Samples
60
50
40
30
20
10
0
24
55
7
6
8
9
13
13
0.0
0.5
1.0
1.5
2.5-3.5
5.0-5.5
6.0-10.0
10.5-15.0
Sample Depth (ft)

Date: 07/10/95



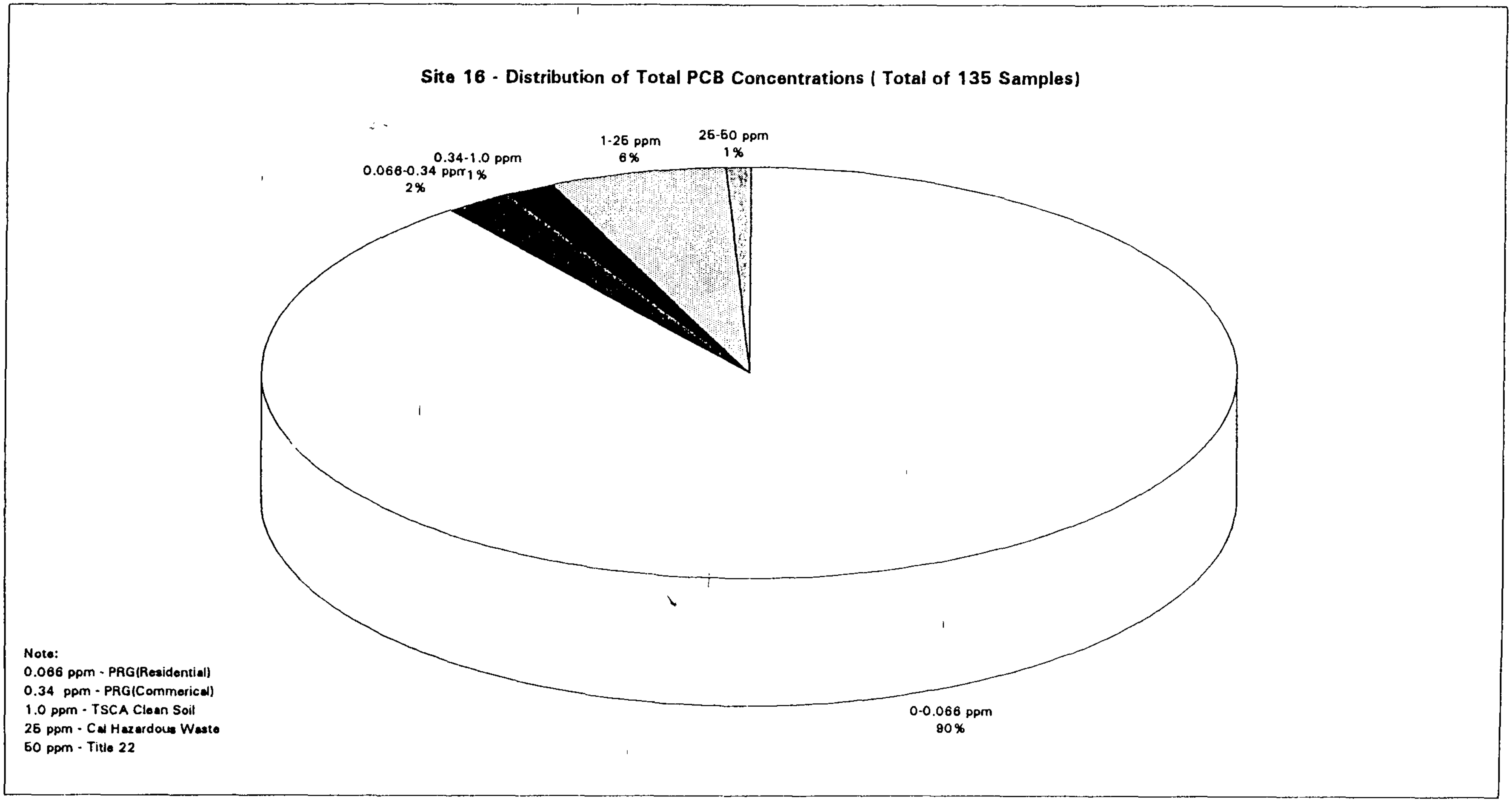
*: Total PCBs was calculated by using half of the detection limits with a maximum conc. of 0.625 ppm to represent samples reported "ND".

Date: 07/10/95



Site 16 - Distribution of PCB Concentrations (Total of 135 Samples)
70
60
50
40
30
20
10
0
# of Samples
67
1
12
24
14
3
3
2
8
1
ND < 0.1
ND 0.1-0.5
ND 0.5-1.0
ND 1.0-3.0
ND >3.0
< 0.066
0.067-0.34
0.35-1.0
1-25
25-40
Concentration Range (ppm)

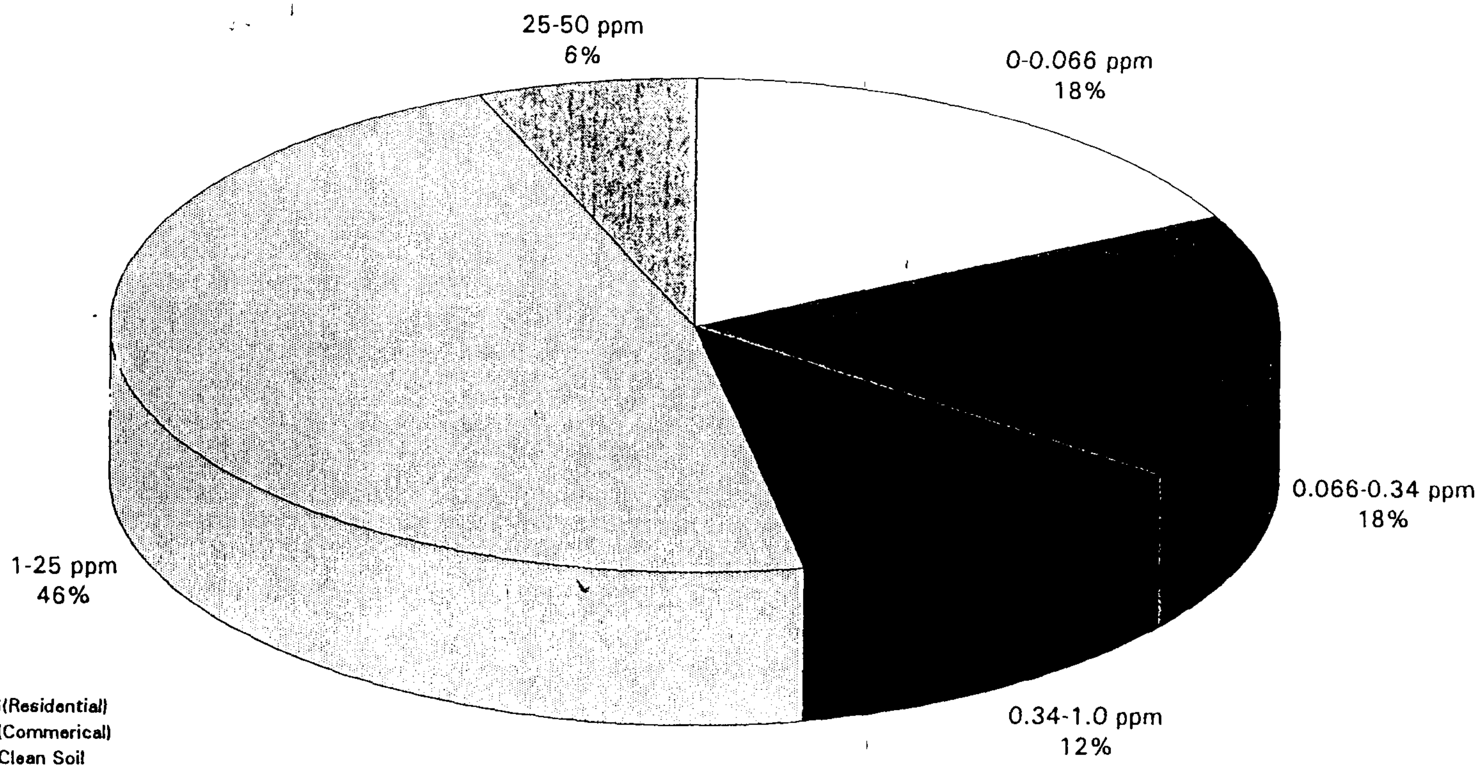
Date: 07/10/95



Site 16 - Distribution of Total PCB Concentrations (Total of 135 Samples)
0.066-0.34 ppm
2%
0.34-1.0 ppm
1%
1-25 ppm
6%
25-50 ppm
1%
0-0.066 ppm
90%
Note:
0.066 ppm - PRG(Residential)
0.34 ppm - PRG(Commerical)
1.0 ppm - TSCA Clean Soil
25 ppm - Cal Hazardous Waste
50 ppm - Title 22

Date: 07/10/95

Site 16 - Distribution of Detected PCB Concentrations (Total of 17 Samples)



Note:
0.066 ppm - PRG(Residential)
0.34 ppm - PRG(Commerical)
1.0 ppm - TSCA Clean Soil
25 ppm - Cal Hazardous Waste
50 ppm - Title 22

Date: 07/10/95

APPENDIX A
- Section 3

Site - 16

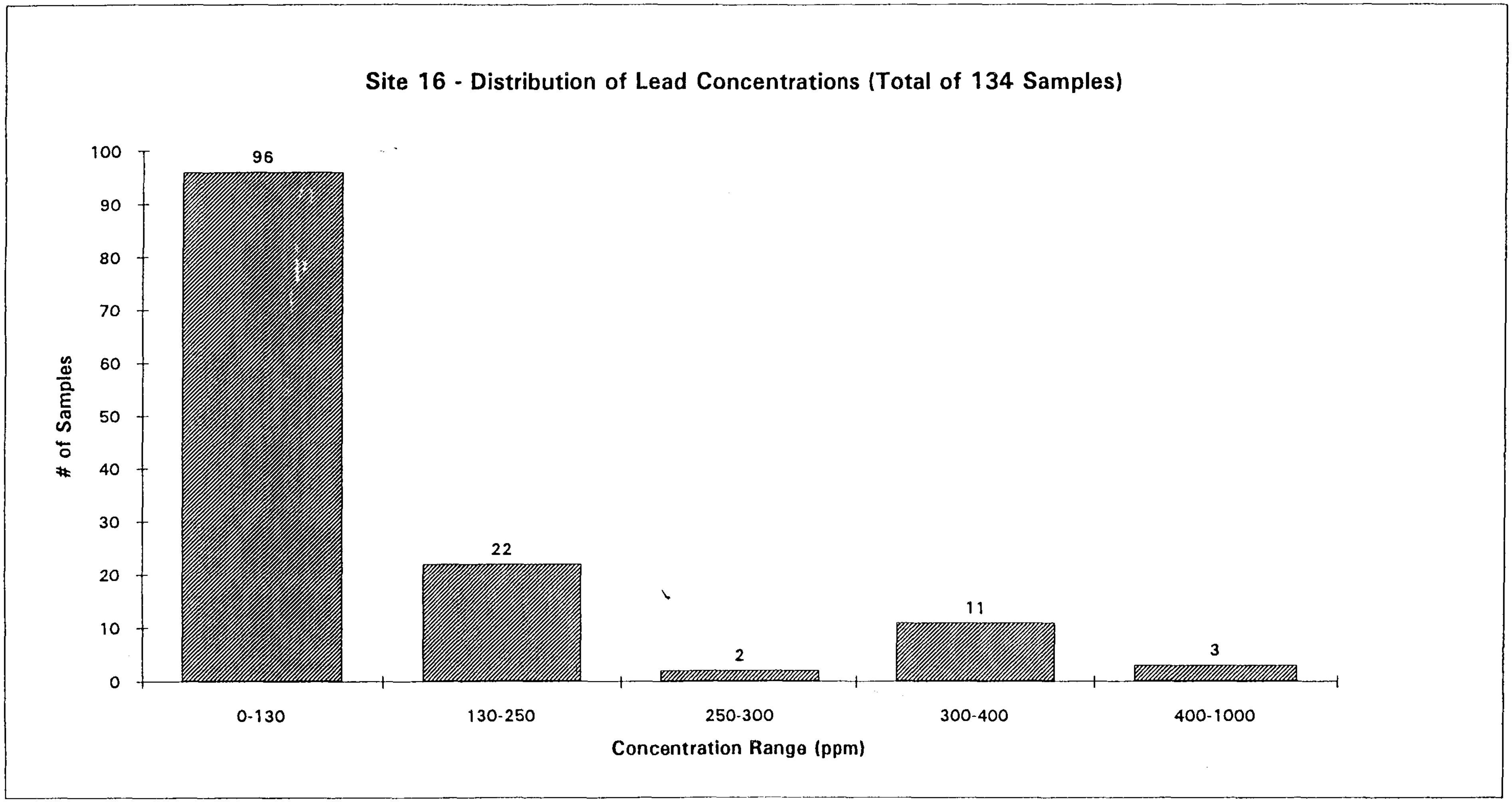
- Lead in Soil Samples

X	Y	Sample Depth (ft)	Sample #	Lead (ppm)	Lead (ppm) Absolute Value
160	150	0.5	SSC2-39	500.00	500.00
65	475	0.5	SSC2-13	420.00	420.00
120	150	0.5	SSC2-30	420.00	420.00
60	400	0.5	SSC2-15	380.00	380.00
160	270	0.5	SSC2-37	380.00	380.00
250	445	0.5	SSC2-23	360.00	360.00
140	0	0.0	NPS-S16-02DUP	347.00	347.00
110	440	0.5	SSC2-24	340.00	340.00
110	400	0.5	SSC2-25	330.00	330.00
60	520	0.5	SSC2-12	320.00	320.00
60	440	0.5	SSC2-14	320.00	320.00
110	275	0.5	SSC2-28	310.00	310.00
160	120	0.5	SSC2-40	310.00	310.00
125	200	0.5	SSC2-29	300.00	300.00
160	500	0.5	SSC2-32	280.00	280.00
120	550	0.0	NPS-S16-01	250.00	250.00
160	450	0.5	SSC2-33	240.00	240.00
100	530	0.5	SSC2-22	230.00	230.00
0	470	0.5	SSC2-3	230.00	230.00
145	550	0.5	SSC2-31	230.00	230.00
90	550	0.5	SSC2-21	220.00	220.00
160	410	0.5	SSC2-34	220.00	220.00
160	200	0.5	SSC2-38	220.00	220.00
70	110	0.5	SSC2-20	210.00	210.00
70	210	0.5	SSC2-19	200.00	200.00
140	0	0.0	NPS-S16-02	185.00	185.00
60	560	0.5	SSC2-11	180.00	180.00
65	370	0.5	SSC2-16	180.00	180.00
0	510	0.5	SSC2-2	180.00	180.00
160	330	0.5	SSC2-36	180.00	180.00
10	550	0.5	SSC2-1	170.00	170.00
110	370	0.5	SSC2-26	160.00	160.00
160	365	0.5	SSC2-35	160.00	160.00
200	365	0.5	SSC2-45	144.00	144.00
60	325	0.5	SSC2-17	140.00	140.00
200	410	0.5	SSC2-44	137.00	137.00
110	330	0.5	SSC2-27	130.00	130.00
0	430	0.5	SSC2-4	130.00	130.00
0	100	0.5	SSC2-10	120.00	120.00
0	320	0.5	SSC2-7	120.00	120.00
0	350	0.5	SSC2-6	110.00	110.00
0	270	0.5	SSC2-8	100.00	100.00
490	140	0.0	S16-68	99.10	99.10
0	390	0.5	SSC2-5	92.00	92.00
150	590	0.0	S16-70	85.80	85.80

X	Y	Sample Depth (ft)	Sample #	Lead (ppm)	Lead (ppm) Absolute Value
0	200	0.5	SSC2-9	83.00	83.00
60	270	0.5	SSC2-18	70.00	70.00
410	510	0.0	S16-58	56.90	56.90
390	220	0.0	S16-62	37.60	37.60
110	550	3.0	MWC2-1	35.00	35.00
200	310	0.5	SSC2-46	28.50	28.50
90	470	13.5	BC2-4	23.00	23.00
200	450	0.5	SSC2-43	22.60	22.60
200	120	0.5	SSC2-50	18.20	18.20
260	370	0.5	SSC2-52	18.10	18.10
260	210	0.5	SSC2-55	17.40	17.40
285	55	0.0	S16-57	16.70	16.70
200	150	0.5	SSC2-49	16.70	16.70
200	500	0.5	SSC2-42	16.40	16.40
260	505	0.5	SSC2-51	14.70	14.70
110	550	11.5	MWC2-1	14.00	14.00
200	270	0.5	SSC2-47	13.90	13.90
200	550	0.5	SSC2-41	13.40	13.40
200	200	0.5	SSC2-48	12.30	12.30
260	260	0.5	SSC2-54	12.10	12.10
260	310	0.5	SSC2-53	11.30	11.30
390	140	0.0	S16-63DUP	11.00	11.00
390	280	0.0	S16-61	10.20	10.20
15	495	2.5	B16-10-2.5DUP	10.10	10.10
110	550	1.0	MWC2-1	9.00	9.00
380	60	0.0	S16-64	8.80	8.80
0	380	1.5	MWC2-2	8.80	8.80
120	0	1.5	MWC2-3	7.40	7.40
110	550	13.0	MWC2-1	6.80	6.80
170	375	5.5	BC2-6	6.50	6.50
80	380	1.5	BC2-5R	6.40	6.40
315	135	0.0	S16-56	6.20	6.20
480	510	0.0	B16-11-0	5.80	5.80
390	140	0.0	S16-63	5.20	5.20
490	440	0.0	S16-65	4.30	4.30
15	495	0.0	B16-10-0	3.20	3.20
490	360	0.0	S16-66	3.20	3.20
215	590	0.0	S16-71	3.00	3.00
480	230	5.0	M16-04-5.0	2.90	2.90
80	595	0.0	S16-69	2.60	2.60
400	360	0.0	S16-60	2.50	2.50
410	440	0.0	S16-59	2.20	2.20
490	280	0.0	S16-67	1.90	1.90
480	230	2.5	M16-04-2.5	1.90	1.90
480	230	2.5	M16-04-2.5DUP	1.60	1.60
480	230	0.0	M16-04-0	1.40	1.40
480	55	0.0	B16-12-0	-5.00	5.00
15	495	2.5	B16-10-2.5	-5.00	5.00
480	510	2.5	B16-11-2.5	-5.00	5.00
480	55	2.5	B16-12-2.5	-5.00	5.00
15	495	5.0	B16-10-5.0	-5.00	5.00
480	510	5.0	B16-11-5.0	-5.00	5.00

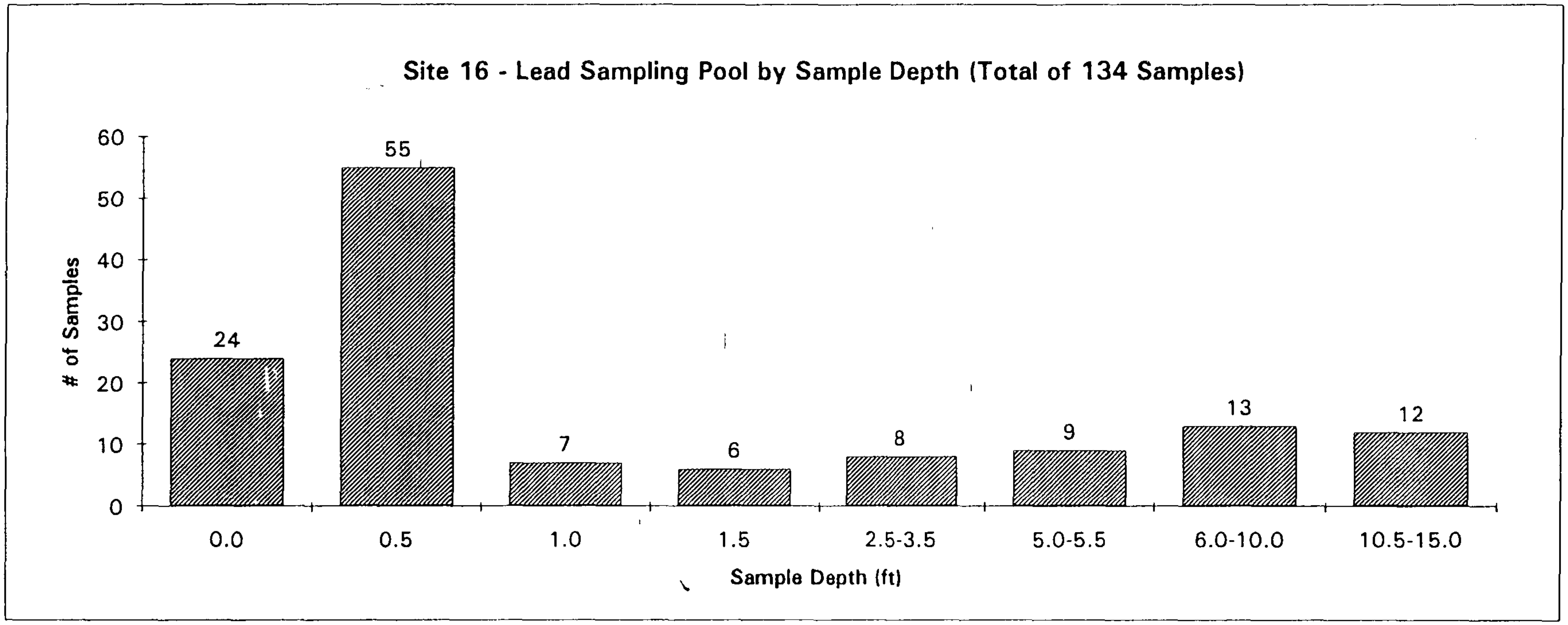
X	Y	Sample Depth (ft)	Sample #	Lead (ppm)	**Lead (ppm)** Absolute Value
480	55	5.0	B16-12-5.0	-5.00	5.00
90	470	1.0	BC2-4	-5.10	5.10
100	85	1.0	BC2-9	-5.10	5.10
170	375	1.0	BC2-6	-5.20	5.20
20	130	1.0	BC2-8	-5.20	5.20
20	130	1.5	BC2-8R	-5.20	5.20
110	550	1.5	MWC2-1R	-5.20	5.20
0	380	3.5	MWC2-2	-5.20	5.20
80	380	1.0	BC2-5	-5.40	5.40
170	375	1.5	BC2-6R	-5.60	5.60
70	250	1.0	BC2-7	-5.80	5.80
170	375	10.0	BC2-6	-5.90	5.90
70	250	14.5	BC2-7	-5.90	5.90
120	0	5.5	MWC2-3	-6.00	6.00
0	380	6.5	MWC2-2	-6.00	6.00
90	470	5.5	BC2-4	-6.10	6.10
70	250	5.5	BC2-7	-6.10	6.10
20	130	5.5	BC2-8	-6.10	6.10
110	550	6.0	MWC2-1	-6.10	6.10
110	550	9.0	MWC2-1	-6.10	6.10
20	130	10.0	BC2-8	-6.10	6.10
100	85	10.0	BC2-9	-6.10	6.10
80	380	14.0	BC2-5	-6.10	6.10
20	130	15.0	BC2-8	-6.10	6.10
100	85	6.0	BC2-9	-6.20	6.20
80	380	7.5	BC2-5	-6.20	6.20
120	0	9.0	MWC2-3	-6.20	6.20
90	470	10.0	BC2-4	-6.20	6.20
70	250	10.0	BC2-7	-6.20	6.20
170	375	14.5	BC2-6	-6.20	6.20
100	85	14.5	BC2-9	-6.20	6.20
120	0	7.5	MWC2-3	-6.30	6.30
0	380	12.5	MWC2-2	-6.30	6.30
120	0	13.0	MWC2-3	-6.30	6.30
0	380	15.0	MWC2-2	-6.40	6.40
0	380	9.5	MWC2-2	-6.50	6.50
120	0	10.5	MWC2-3	-6.50	6.50

Note: Canonie - 100 samples, PRC - 34 samples, total of 134 samples.
"-" = "less than", reported as "ND".
Sample with the highest concentration of Lead.



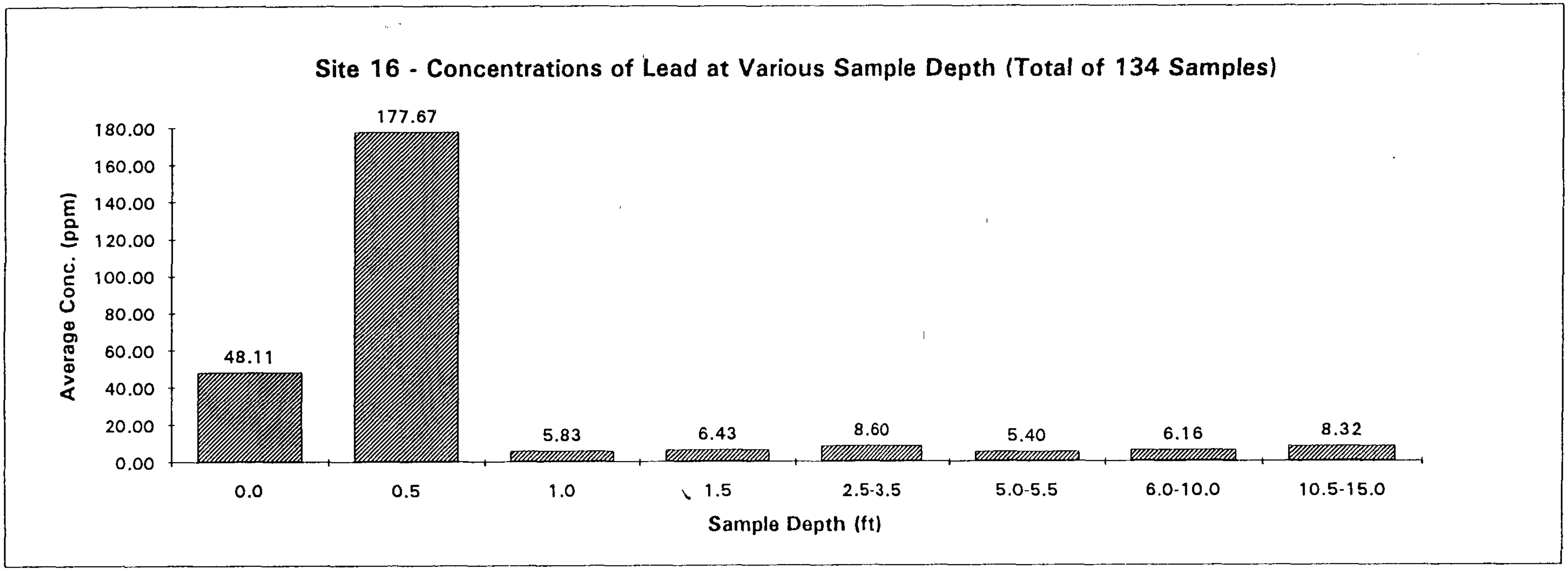
Site 16 - Distribution of Lead Concentrations (Total of 134 Samples)
# of Samples
100
90
80
70
60
50
40
30
20
10
0
96
22
2
11
3
0-130
130-250
250-300
300-400
400-1000
Concentration Range (ppm)

Date: 07/10/95



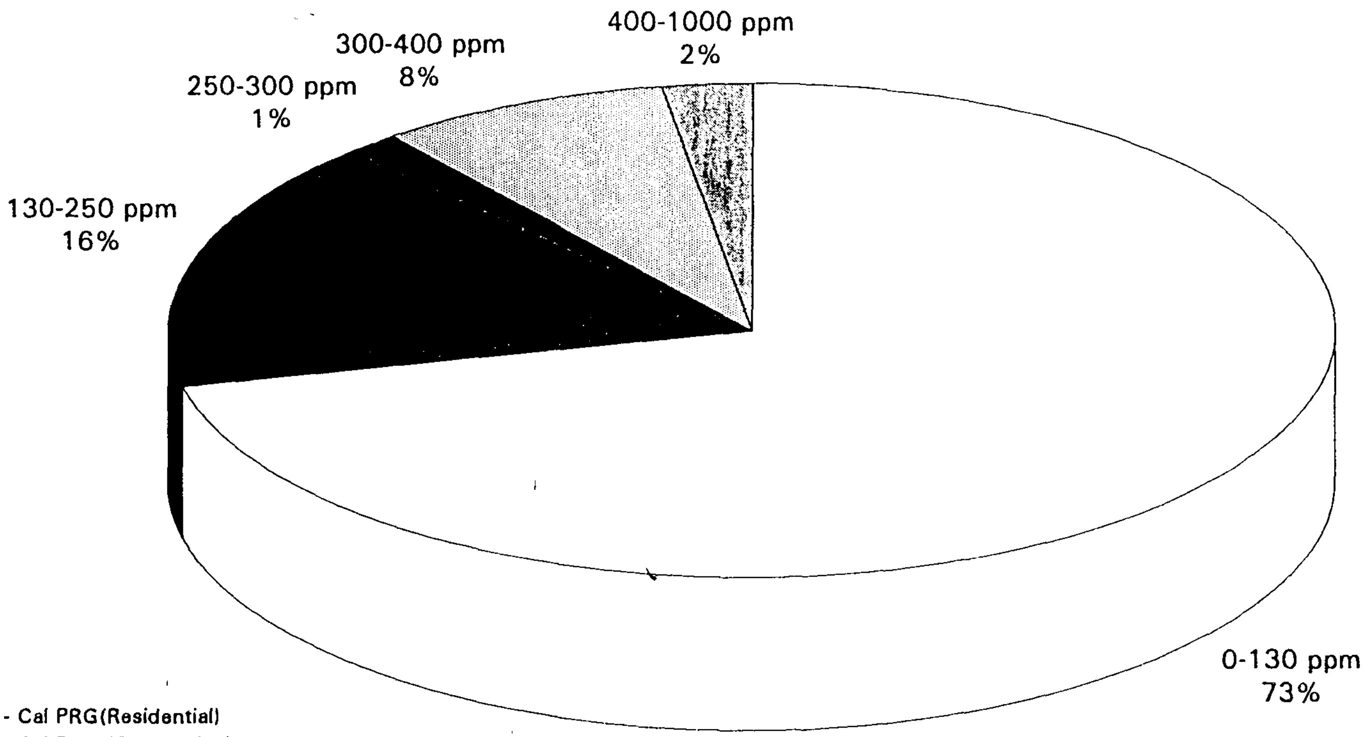
Site 16 - Lead Sampling Pool by Sample Depth (Total of 134 Samples)
# of Samples
60
50
40
30
20
10
0
24
55
7
6
8
9
13
12
0.0
0.5
1.0
1.5
2.5-3.5
5.0-5.5
6.0-10.0
10.5-15.0
Sample Depth (ft)

Date: 07/10/95


Site 16 - Concentrations of Lead at Various Sample Depth (Total of 134 Samples)
Average Conc. (ppm)
180.00
160.00
140.00
120.00
100.00
80.00
60.00
40.00
20.00
0.00
48.11
177.67
5.83
6.43
8.60
5.40
6.16
8.32
0.0
0.5
1.0
1.5
2.5-3.5
5.0-5.5
6.0-10.0
10.5-15.0
Sample Depth (ft)

Date: 07/10/95

Site 16 - Distribution of Lead Concentrations (Total of 134 Samples)



Note:
130 ppm - Cal PRG(Residential)
250 ppm - Cal PRG (Commerical conservative)
300 ppm - Site 16 Cleanup Level
400 ppm - EPA PRG (Residential)
1000 ppm - EPA PRG (Commerical)

Date: 07/10/95

APPENDIX A
- Section 4

Compilation of Historical Data for Site 16 will be included in the Final EE/CA

APPENDIX B

APPENDIX B

B.1.0 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

The NCP states, "Removal actions . . . shall to the extent practicable considering the exigencies of the situation, attain applicable or relevant and appropriate requirements under federal environmental or state environmental or facility sighting laws."

Removal actions, such as those proposed for Site 16, must attain levels of cleanup of past releases of hazardous substances, pollutants, or contaminants and control potential future releases to mitigate potential adverse effects to human health and the environment. In analyzing remedial alternatives, the selected alternative must be consistent with Applicable or Relevant and Appropriate Requirements. These are known as ARARs and are defined by the U.S. Environmental Protection Agency (EPA, 1988) as:

Applicable Requirements are those cleanup standards, control standards, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that specifically address a hazardous substance, pollutant, contaminant, remedial action, or other circumstance at a site.

Relevant and Appropriate Requirements are those cleanup standards, control standards, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that, while not "applicable" to a hazardous substance, pollutant, contaminant, remedial action, or other circumstances at a site, address problems or situations sufficiently similar to those encountered at the site that their use is well suited to the particular site.

B.1.1 Applicable Requirements

Applicable Requirements that will effect the handling, treatment, and final disposition of COC affected media during the Site 16 removal action are summarized and then discussed in detail as follows.

Federal Statutes and Regulations:
* SARA
* TSCA; and
* 40 CFR part 50.

State of California and Local Agencies:
* CCR Title 22;
* CCR Title 8;
* Bay Area Air Quality Management District Regulations;
* POTW requirements for discharge of waters.

Section 121 of SARA (1986) requires remedial actions to be protective of human health and the environment. Compliance with the following ARARs should provide for adequate protection.

40 CFR Part 761-Subchapter R - TSCA - Polychlorinated Biphenyls Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions, lists specific requirements for cleanups of PCBs including handling and disposal. A particular requirement is that soil placed at a site shall contain less than 1 ppm PCBs.

40 CFR Part 50 - National Primary and Secondary Ambient Air Quality Standards, lists the ambient air quality standards for particulate matter as 150 micrograms per cubic meter for 24 hours, and 50 micrograms per cubic meter as the annual arithmetic mean average of. The standards are measured as PM10 and are applicable for excavation or other activities that may generate air emissions (e.g., fugitive dust). Air monitoring will be conducted to ensure air quality is not impacted.

CCR Title 22 - Environmental Health Standards for the Management of Hazardous Waste, includes both the State of California and the RCRA regulations for the management of hazardous waste. The chapters of this Title discuss the proper characterization, handling, and disposal of hazardous waste that may generated during soil treatment processes to be conducted at the site. Title 22, Chapter 18 identifies hazardous wastes that are restricted from land disposal and defines those limited circumstances under which an otherwise prohibited waste may continue to be land disposed. Chapter 18, Section 66268.29 lists PCB waste as being restricted from land disposal and Section 66268.41 and 66268.43 list treatment standards and/or waste concentration limits for land disposal of contaminants including PCBs. The requirements of this chapter shall not affect that availability of a waiver under Section 121(d)(4) of Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). Also, it should be noted that, although Site 16 soils contain detectable concentrations of PCB, the concentrations of all the samples analyzed are well below hazardous waste criteria promulgated in these regulations, but concentrated waste products produced by remedial actions may have concentrations of COCs that exceed hazardous waste criteria if they are not suitable for recycling.

California Clean Air Act of 1988, as implemented by the Bay Area Air Quality Management District, includes Regulation 2 requiring permitting for new sources and could be applicable for the proposed treatment of PCBs and lead. Other relevant rules include Regulation 6 restricting particulate emissions during grading and treatment, and Regulation 11/Rule 1 restricting emissions of particulates containing lead.

CCR Title 8 - General Industry Safety Order is the state occupational health and safety regulations. Section 5155 limits the amount of dust generated during site activities to the 8-hour time weighted averages for nuisance dust of 10 milligrams per cubic meter. Similarly, Section 5216 limits the 8-hour time weighted averages for lead emissions to 50 micrograms per cubic meter.

California Health and Safety Code was recently amended by Senate Bill 1706 (specifically, Sections 25356.1 and 25358.9 were amended, and Section 25323.1 was added). It includes substantive provisions, conditions, and requirements for preparation of a remedial action work plan for non-emergency removal actions. As specified, the removal action work plan described shall include a description of the on-site contamination, the goals to be achieved by the removal action, any alternative removal actions that were considered and rejected and the basis for that rejection, and a detailed engineering plan. Compliance of this document with these provisions is summarized below:

RAW Requirements	Documentation
* Description of On-site Contamination	EE/CA - Section 1.0
* Removal Action Goals	EE/CA - Section 2.0
* Alternatives Considered and Rejected	EE/CA - Sections 3.0 and 4.0
* Identification of Removal Action and Detailed Engineering Plan	EE/CA - Section 5.0 and Implementation Work Plan

B.1.2 Relevant and Appropriate Requirements

Relevant and Appropriate Requirements are standards that, while not "applicable" address problems or situations sufficiently similar to those encountered at the site that their use is well suited to the particular site. These include guidance ARARs that will be used to assess remediation and treatment goals including media re-use ARARs. Relevant and Appropriate Requirements are summarized and then discussed in detail as follows.

Federal guidance for clean-up levels include:

* USEPA guidance for clean-up of PCB affected sites;
* USEPA Region IX PRGs; and
* USEPA discretionary guidance for site-specific clean-up of PCBs.

State of California guidance for clean-up levels include:

* CAL-EPA PRGs; and
* SFBRWQCB policy for re-use of soils containing contaminants.

USEPA Region IX PRGs [USEPA 1995] are health-based values used to predict single-contaminant health risks for specific media. While these values do not necessarily represent site specific cleanup criteria, they are a useful tool in screening sites to identify contaminants that should be evaluated. A PRG, residential scenario, of 400 ppm is established for the metal lead. For the PCB Aroclor 1260 a PRG residential scenario of 66 parts per billion (ppb) and a commercial scenario PRG of 340 ppb are proposed by the USEPA. PRGs for the other site Aroclors allow higher concentrations of PCBs compounds.

Guidance on Remedial Actions for Superfund Sites with PCB Contamination [USEPA 1990] recommends a 1 ppm soil action level for PCBs when remediating contaminated soils for residential land use. The action level is determined by a risk-basked calculation that considers ingestion, inhalation, and dermal contact as the exposure pathways.

CAL-EPA PRGs for the metal lead, which are risk-based values used to predict single contaminant risks for different media. While these values do not necessarily represent site specific cleanup criteria, they are a useful tool in screening sites to identify contaminants that should be evaluated. A PRG, residential scenario, of 130 parts per million (ppm) is established for the metal lead, but is subject to revision upward based on site-specific conditions and the extent of the lead problem at the site.

SFBRWQCB policy for re-use of soil containing residual lead and/or PCBs will require testing of the soils to determine the soluble residual concentrations for these compounds and then evaluating the attenuation capacity of the site soils prior to replacing the soils at the site.

B.2.0 GENERAL REVIEW REQUIREMENTS

The CAL-EPA DTSC and SFBRWQCB require, at a minimum, review of requirements in the following State laws and regulations to ensure consistency with other similar activities conducted within the State.

The California Environmental Quality Act (CEQA) requires the potential environmental impacts of remedial actions proposed for a cleanup site be analyzed. Activities that have a potential impact on the environment must be identified and mitigation measures proposed. The CEQA process will be completed by CAL-EPA DTSC which is the agency having state lead for completing CEQA. Based on site information, no endangered species, cultural resources, wetlands, or flood plains have been identified at Site 16.

California Hazardous Substances Cleanup Bond Act of 1984 and the Hazardous Substance Account Act of 1981 (Chapter 6.8 of the California H&SC) regulate the generation of hazardous waste.

Waters of the State are protected by regulations and policies, implemented by the SFBRWQCB, including the Basin Plan (mandated by the Porter-Cologne Act) and by CCR Title 23 (Waters).

Other waters policies that need to be considered include:

* SWRQCB Resolution 92-49, which establishes procedures and policies for implementing State Water Code Section 13304.
* SWRQCB Resolution 88-63 (established policy on determining suitability of surface water and groundwater for municipal or domestic water supply).
* SFRWQCB Resolution 89-039 incorporates Resolution 88-63 into the San Francisco Bay Basin Water Quality Control Plan.
* SWRQCB resolution 68-16 - Maintaining High Quality of State Waters Policy.
* California Safe Drinking Water Act of 1983 (Maximum Containment Levels for organic chemicals).

Groundwater in the site vicinity has not been impacted by PCBs or lead; however other compounds have been detected in monitoring wells installed at Site 16. For purposes of this removal action, only soil located above the free groundwater table will be removed. No treatment of groundwater, beyond what is required due to excavation of soil, is anticipated.

California Business and Professions Code Section 7028.1, 7058.7, and 7228.6 and California Labor Code Section 142.7, which involve licensing, training, and worker safety requirements for contractors will have to be complied with by remedial action contractors conducting construction activities.

B.3.0 AGENCIES WITH REVIEW, PERMITTING, AND OVERSIGHT RESPONSIBILITIES

Regulatory agencies that will have oversight responsibilities for site activities and remedial action alternatives analyses include:

USEPA - All remedial activities will be subject to USEPA's oversight and approval.

CAL-EPA DTSC- All remedial activities will be subject to DTSC's oversight and approval.

BAAQMD - Will permit activities and enforce requirements restricting discharges of pollutants to the atmosphere during remediation of the site.

EBMUD will determine if discharge of waste waters to the sanitary sewer system will be allowed.

SFRWQCB will determine if treated soil containing residual concentrations of contaminants can be re-used at the site. Also, the SFRWQCB will decide if an NPDES permit can be issued if treated groundwater is to be discharged to surface waters or to a storm drain.

APPENDIX C

APPENDIX C

C.1.0 IDENTIFICATION AND SCREENING OF GENERAL RESPONSE ACTIONS

General response actions describe those actions that will satisfy the removal action objectives described in Section 3.5. The following general response actions for the removal action at Site 16 at NAS Alameda were identified:

1. No Action
2. Institutional Control Actions
3. Containment Actions
4. Removal and Disposal Actions
5. In-Situ Treatment Actions
6. Ex-Situ Treatment Actions

These response actions are discussed below.

No Action

The no-action response specifies no remediation of soil at the site. It directs that no action would be performed concerning the site contaminants, but may include periodic inspection, monitoring and reporting. The CERCLA requires, as stated in the NCP, that the no-action response be retained through the remedial evaluation process. Therefore, this general response action is retained for further consideration.

Institution Actions

Institutional response actions involve only access and deed restrictions for the site. Institutional actions alone, such as perimeter fencing, generally provide minimal protection to human health and the environment and are not considered permanent soil remediation solutions. Therefore, institutional actions are eliminated from further consideration.

Containment Actions

Containment actions provide physical containment of chemicals of concern in the affected media to prevent exposure and further migration. Containment actions, such as slurry walls, and grout curtains, may be cost-prohibitive for large areas of containment. Capping may be feasible for Site 16 since it prevents exposure and further contaminant migration through leaching. Containment remedies require long-term land use or exposure restrictions to maintain their protectiveness. Furthermore, containment provides limited protection to human health and the environment and would not permit land reuse. Containment actions are therefore, eliminated from further consideration except for Soil Capping which is retained for further evaluation.

Removal and Disposal Actions

Removal and disposal actions involve physical removal and disposal of the contaminated soil. These actions can provide the highest degree of protection of human health and the environment by removing the source of contamination. Removal and disposal actions may be cost-prohibitive if large volumes of soil require remediation prior to disposal. In addition, the Navy may be liable in the future for its landfilled waste. However, these response actions are feasible and easy to implement; therefore, they are retained for further consideration.

In-Situ Treatment Actions

In-situ treatment actions involve treatment of the soil without physical removal. Because these actions can (for certain contaminants) provide a high degree of contaminant removal and destruction of chemicals, a high degree of protection of human health and the environment would be attained. Although in-situ actions are generally less reliable than removal and disposal actions, these actions may be cost-effective when large volumes of soil require remediation. However, except for in-situ fixation, these treatment technologies have not been proven to be effective for PCBs or lead or they cannot be used in shallow soils. Thus, only In-Situ Fixation is retained for further consideration.

Ex-Situ Treatment Actions

Ex-situ treatment actions involve treatment of the soil after it has been physically removed. Like in-situ treatment actions, these actions can provide a high degree of contaminant removal or destruction of chemicals, and thus provide a high degree of protection of human health and the environment. Ex-situ actions are retained for further analysis.

C.2.0 SCREENING OF TREATMENT TECHNOLOGIES

Potentially applicable technologies were screened to identify implementable technologies that can be used in the development of remedial alternatives. The screening was based on the relative effectiveness, technical and institutional implementability, and preliminary cost for each technology type and process option. A summary of this screening is presented in Table C-1. The last two columns of the table indicate whether the process option will be retained for further evaluation, and includes comments regarding elimination or consideration of the technology or process option. Table C-2 includes a wide range of potential alternative technologies to ensure that no reasonable alternative was overlooked.

C.2.1 No Action

For this general response action, the site is left as is and no action is taken. No soil and groundwater monitoring will be required. This action is generally retained to serve as a baseline for comparison with other removal action alternatives during the detailed analysis. Therefore No Action alternative will be considered for further evaluation.

C.2.2 Removal and Disposal Actions

Removal and disposal actions consist of physical removal and disposal of untreated or treated soils on site or at an off-site facility. Any excavated soil, whether treated or untreated, will require proper disposal. Chemical analysis would be required at the time of soil excavation to establish whether treatment is necessary pursuant to the Land Disposal Restrictions (LDRs) set forth in 40 CFR 268 and in CCR 22-66268. Section 2.5 discusses the California-hazardous levels for PCBs and lead and the disposal regulations under TSCA, RCRA, and CCR. California non-RCRA waste may be subject to treatment standards pursuant to the LDRs. In April 1992, the Governor of California signed into law Senate Bill (SB 611, Chapter 33 of the 1992 Statute), and extended the effective date to January 1, 1993, of treatment standards for solid hazardous waste containing metals (for example, lead). In August 1992, a subsequent bill, SB 1726 (Chapter 853 of the 1992 Statute), further extended the deadline for wastes addressed in the earlier bill, but also for some additional wastes. SB 1726 extended the prohibition date to January 1, 1995 for non-RCRA solid hazardous waste containing metals (for example, lead) and for non-RCRA hazardous wastes whose treatment standards are based on incineration, solvent extraction, or biological treatment (for example, PCB-containing waste). Therefore, land disposal of Site 16 soil containing PCBs and lead may become difficult in the near future.

C.2.2.1 Excavation

Excavation of soil at Site 16 would involve the use of general earthwork equipment. Before excavating soil, site preparation activities would be conducted, including removing the perforated runway plates that cover most of the soil surfaces, decommissioning utilities, removing site fencing, destroying monitoring wells, and performing preliminary earthwork necessary for excavation. Since the excavation depth is anticipated to be less than two feet, sloping or shoring would not be required in accordance to California Occupational Safety and Health Administration (OSHA) regulations 1540 and 1541. Excavation alleviates containment mobility at the site and is easy to implement. However, no long-term effectiveness or permanence is achieved without additional treatment. During excavation, the removal action may pose a potential health and safety risk to site workers through skin contact and air emissions. However, these risks can be mitigated with the use of appropriate health and safety controls (for example, personal protective equipment). Excavation is considered feasible and is retained for further consideration.

C.2.2.2 On-Site Disposal

On-site disposal options include backfilling into the excavation area or potential use of contaminated soil at other on-site locations. Before disposing of excavated soil on site, this option would require pretreatment of soil for PCBs and lead to meet state and federal LDRs. On-site disposal is considered implementable and is retained for further consideration.

C.2.2.3 Off-Site Disposal

In this process, the excavated soil would be transported to a permitted off-site facility for disposal. Off-site disposal facilities include Class I, II, III, and recycling facilities. If the soil contains levels of contaminants exceeding their corresponding LDR, pretreatment of the contaminated media through ex situ technologies is required prior to disposal. Additionally, transportation to an off-site facility introduces a potential risk to the community via accidental releases.

Class I Facility

Class I treatment and disposal facilities often are capable of treating a variety of hazardous wastes, and therefore, may accept both nonhazardous and hazardous waste, as defined by 40 CFR 268 and Title 26, Div. 22 CCR 66268, for disposal. At the various Class I facilities, a solidification or stabilization process is used to pretreat soils containing lead if the leachable lead concentration exceeds the LDR. Pretreatment processes are also utilized to immobilize high PCBs in soils. The effectiveness of immobilization in meeting the treatment standards is confirmed by a treatability study prior to acceptance. This option is retained for further evaluations.

Class II and III Facilities

Class II and III disposal facilities provide limited or no waste treatment services. Class II facilities may accept treated hazardous waste for disposal. However, Class II disposal facilities are limited in number, and treated hazardous wastes are generally accepted only on a case-by-case basis. Class III disposal facilities accept soil waste that is considered nonhazardous, and generally do not accept treated hazardous waste for disposal. Therefore, while Class III facility disposal is not feasible, Class II facility disposed option is retained for further consideration.

Recycling Facility

Recycling facilities treat soils to generate a nonhazardous product that can be used as an admixture for road paving or ground cover for landfill sites. Recycling facilities generally accept nonhazardous wastes and may accept hazardous wastes. However, these soils will not be accepted for recycling based on discussions with recycling facility personnel regarding the elevated PCBs and the lead concentration ranges detected in Site 16 soils. Therefore, this option is eliminated from further analysis.

C.2.3 In-Situ Treatment Actions

In-situ treatment technologies include a variety of biological, chemical, and electrical processes. All of the in-situ treatment options listed on Table C-2 are eliminated from further consideration. As discussed in detail below, these treatment technologies were eliminated primarily because they have not been proven to be effective for PCBs or lead or they cannot be used in shallow soils.

C.2.3.1 Biological Treatment

In-situ aerobic and anaerobic biological treatment technologies have been used to degrade PCBs in soil. However, biological treatment of PCBs is a slow process. In general, highly chlorinated PCBs (such as Aroclor-1260) are more resistant to biological degradation than less-chlorinated PCBs (for example, Aroclor-1242) (McCoy and Associates, Inc. 1992). The extent of degradation is highly dependent on numerous factors such as degree of chlorination, moisture content, pH, temperature, oxygen, and nutrient concentrations. Degradation of PCBs by aerobic bacteria has been observed in laboratory experiments; however, this process has not been fully demonstrated in the field. Degradation of PCBs through anaerobic processes is potentially feasible; however, maintaining anaerobic conditions would be difficult in shallow vadose zone soil (that is, less than two feet bgs) at Site 16. In addition, to ascertain the effectiveness of biological treatment processes in treating the contaminated soil, extensive site characterization and treatability studies would have to be conducted. This remedial technology is not effective for treating heavy metals. Elevated levels of metals (for example, lead) present in soil are also likely to be toxic to the microbes. Therefore, in-situ biological treatment is removed from further consideration.

C.2.3.2 Chemical Treatment

An in situ chemical treatment process has been identified as potentially applicable for PCBs and lead in soils; this process is solidification and stabilization (fixation). The contaminants are physically bound or enclosed within a stabilized mass (solidification), or chemical reactions are induced between the stabilizing agent and contaminants to reduce their mobility (stabilization). Both solidification and stabilization prevent leaching of contaminants. Attempts to solidify or stabilize PCB-containing wastes to render them immobile have achieved mixed results, but this treatment technology is proven to immobilize heavy metals (for example, lead). Treatability studies are required to ascertain if wastes are compatible with this process and to establish treatment conditions for site soil. Fixation or solidification and stabilization processes may result in a significant increase in the volume of immobilized waste. In addition, in situ environmental conditions may affect ability to maintain immobilization of contaminants. In-situ fixation is easy to implement and may be cost-effective for Site 16. Thus, in-situ fixation is retained for further consideration.

C.2.3.3 Thermal Treatment

In-situ thermal treatment processes include vitrification, which involves the use of high power electrical current (approximately 4 megawatts) transmitted into the soil by large electrodes that transform the treated material into a pyrolyzed mass. Organic contaminants (for example, PCBs) are destroyed or volatized, and inorganic contaminants (for example, lead) are bound up in the glass-like mass that is created. Organic and inorganic off gases must be controlled and treated. The high voltage used in the in situ vitrification process, as well as control of the offgases, present potential health and safety risks. The efficiency of in situ vitrification requires homogeneity of the target media. As with solidification or stabilization processes, vitrification could limit further use of the site. In-situ vitrification is a relatively complex, high-energy technology requiring a high degree of skill and training. Overall costs of this treatment technology are prohibitively high (higher than biological and solidification or stabilization processes) and regulatory and community acceptance are expected to be difficult to attain. Therefore, in situ vitrification is not considered further.

C.2.4 Ex-Situ Treatment Actions

Ex-situ treatment actions for treating excavated soil include technologies that specifically act to reduce the toxicity and volume of the chemicals of concern by physical, biological, chemical, or thermal processes. These treatment technologies can be implemented both on and off site.

C.2.4.1 Physical Treatment

Physical treatment technologies involve physically separating chemicals of concern from soil. Ex-situ physical treatment processes considered for soils at Site 16 at NAS Alameda include soil washing. The soil washing process separates contaminants absorbed onto soil particles from soil in an aqueous-based system. The wash water may be augmented with a basic leaching agent, surfactant, pH adjustment, or chelating agent to help remove organics or heavy metals. Soil washing has been demonstrated to be effective for removal of metals (for example, lead) and for PCBs. Fine soil particles, such as silts and clays, are however difficult to remove from the washing liquid. Soil washing is easy to implement and is retained for further evaluation.

C.2.4.2 Biological Treatment

Bioremediation processes potentially applicable for treating excavated soils include controlled solid-phase biological treatment and white-rot fungus and slurry-phase bioremediation. Controlled solid phase processes include prepared treatment beds, biotreatment cells, soil piles, and composting. Moisture, heat, nutrients, oxygen, and pH can be controlled to enhance biodegradation. In general, highly chlorinated PCBs (for example, Aroclor-1260) are more resistant to biological degradation than less chlorinated PCBs. Treatability testing is needed to evaluate biodegradability of contaminants and appropriate oxygen and nutrient loading rates. Inorganics (for example, lead) are not effectively remediated through biological processes, and elevated concentration of heavy metals may be toxic to the microbes. Because biological degradation of PCBs has not been demonstrated in field studies and is not effective for treating lead, controlled solid-phase biological treatment processes are eliminated from further consideration.

Laboratory studies indicate that PCBs can be dechlorinated through the use of white rot fungus. White rot fungus is cultivated in a reactor, then forced into a secondary metabolic state by altering the reactor conditions. In this state, the fungus excretes enzymes capable of degrading organic compounds through catalytic oxidation reactions. Although white rot fungus has been successfully demonstrated to dechlorinate Aroclor-1242, -1254, and -1260 in laboratories, this treatment technology is not considered by EPA to be a demonstrated technology for pilot-scale use. In addition, white rot fungus is not effective in treating heavy metals such as lead. Therefore, white rot fungus is eliminated from further consideration.

In slurry-phase bioremediation, an aqueous slurry is created by combining soil or sludge with water and other additives. The slurry is mixed to keep soils suspended and microorganisms in contact with the soil contaminants. Nutrients, oxygen, and pH in the bioreactor may be controlled to enhance biodegradation. Upon completion of the process, the slurry is dewatered and the treated soil disposed. IGT has developed and demonstrated a cost-effective slurry-phase remediation technology known as the MGP-REM process for contaminated soils. The technology is based on the enhancement and acceleration of indigenous biological activity and the application of chemical treatment. The chemical treatment uses hydrogen peroxide and iron salt (Fenton's reagent) to oxidize polynuclear aromatic hydrocarbons (PAHs), making them more amendable to biological treatment. The MGP-REM process is faster and achieves a significantly higher degree of cleanup than the conventional biological process alone. Moreover, it costs no more than conventional bioremediation and is considerably less expensive than incineration. IGT successfully field tested the technology in the landfarming mode from 1991 to 1993 and in the soil-slurry mode in 1993-94. In-situ field tests are expected to start in 1995. The work is being funded primarily by the Gas Research Institute (GRI), IGT's Sustaining Membership Program, various gas companies, and the U.S. Environmental Protection Agency. This technology is retained for further consideration.

C.2.4.3 Chemical Treatment

Chemical treatment technologies considered for soils at Site 16 at NAS Alameda include solidification or stabilization, acid washing, solvent extraction, chemical dechlorination, and ultrasonic detoxification.

Solidification or stabilization processes are commonly used and best suited for immobilizing inorganics (for example, lead). The technology has varied effectiveness in immobilizing organic contaminants such as PCBs. Ex-situ solidification or stabilization is relatively simple, uses readily available equipment, and has high throughput rates compared to other technologies. Treatability studies are required to finalize the treatment parameters. This treatment process is known to result in significant increases in volume of the immobilized end-product. This treatment technology is considered feasible and is retained for further consideration.

Acid washing (also known as soil leaching) is a remedial action that addresses the limitations of metals removal by soil washing and enables remediation of metals to lower cleanup levels. Acid washing uses chemical processes to remove metals bound to sands, fine silts, and clays. A proprietary acid solution is used to dissolve crystalline metal oxides and chemically bound metals from the soil matrix into the soluble phase. The metals are then precipitated out of the acid wash for recovery, and the leaching solution is recycled through the process. Although acid washing does not effectively treat organics (such as PCBs), this process is effective for remediating metals (such as lead) contamination in soils and is retained for further evaluation.

Solvent extraction separates organic contaminants from solids and concentrates them in the solvent. This process minimizes the volume of waste that requires disposal. Solvent extraction has been proven to reduce PCB levels in soils to 1.0 mg/kg or less and can extract organically bound metals. Solvents used in this treatment process are generally volatile and will degrade readily; therefore, traces of solvent are not likely to remain after the distillation step. This process option is feasible and, therefore, is retained for detailed evaluation in this EE/CA.

Chemical dechlorination processes destroy PCBs by removing the chlorine atoms from the PCB molecule. This alters the chemical structure of the PCB molecule, reducing its toxicity. Dechlorination processes include using alkaline polyethylene glycolate (APEG) reagents (for example, potassium polyethylene glycolate [KPEG] and potassium glycol methyl etherate [KGME]), high-energy radiation (radiolytic dechlorination), metal-hydroxide-saturated solvents combined with photocatalytic effects (photochemical dechlorination), and hydrogen replacement in the presence of a catalyst (catalytic hydrochlorination). All of these processes were developed for treatment of PCBs and are not effective for treatment of heavy metals. In addition, most of these treatment processes are still in the research stages and are considered emerging technologies. Only the APEG dechlorination process has been successfully field tested in treating PCBs. Capital operations & maintenance (O&M) costs are generally high for these processes, including treatment and disposal of process water. Therefore, chemical dechlorination processes are eliminated from further consideration.

An innovative technology that uses high-frequency sound to destroy PCBs has been developed. The technology, called ultrasonic detoxification, removes halogens from organic compounds and renders them less hazardous or nonhazardous. The process involves mixing solid waste with a caustic solution and irradiating the mixture with ultrasonic energy. Specific feed size and material handling requirements can affect applicability or cost. Like chemical dechlorination processes, ultrasonic detoxification does not effectively treat heavy metals and is not yet considered to be a demonstrated technology. Therefore, the process is eliminated from further consideration.

C.2.4.4 Thermal Treatment

Three types of thermal treatment have been identified: incineration, thermal desorption, and the pyroplasmic process. Incineration uses high temperature to volatize and combust (in the presence of oxygen) organic constituents in hazardous waste. Four common designs are rotary kiln, liquid injection, fluidized bed, and infrared incinerators. All four incinerator types have been used successfully to meet the 99.9999 percent destruction requirement for PCBs and dioxins. Volatile metals, such as lead, amy exit the stack or be concentrated in the bottom ash. Air emissions treatment and ash disposal costs are relatively high. Emissions of lead is regulated under the Boiler and Industrial Furnace (BIF) Regulations (Appendix VIII of 40 CFR 261). There are usually specific feed size and material handling requirements that can affect applicability or cost. Although capital and O&M expenditures associated with incinerators are relatively high, this treatment process reduces toxicity and volume of hazardous waste. Therefore incineration is retained for further consideration.

Thermal desorption is an ex-situ means to physically separate volatile and semivolatile contaminants from soil. Contaminated waste is heated between 200°F and 1,000°F, driving off water and volatile contaminants. Thermal desorption has been proven effective in removing organic compounds, but is not designed to destroy them. Chemical contaminants for which bench-scale through full-scale treatment data exist include primarily VOCs, SVOCs, and PCBs. Site-specific treatability studies may be necessary to document the applicability and performance of a thermal desorption system. It has been demonstrated that PCBs can be removed using low temperature thermal desorption (between 200°F to 600°F) systems. Thermal desorption is generally not effective in separating inorganics and metals from contaminated media. The process also generates some residual streams (for example, condensed contaminants and water, fugitive dust, offgas) that must be treated and disposed of. Wastes with a high moisture content, indicative of Site 16 vadose zone soil, can result in low contaminant volatization and increased treatment costs. Thermal desorption is eliminated from further consideration because it is not effective for treating lead, and site soil properties are not conducive to treatment by this process.

Westinghouse Plasma Systems has developed a plasma arc torch that operates at extremely high temperatures and can decompose PCBs to form hydrogen, carbon monoxide, carbon, and hydrogen chloride. This treatment process, called pyroplasmic treatment, has been developed and used only to treat liquids contaminated with PCBs, and has not been proven to be effective for PCBs in soil. Therefore, pyroplasmic treatment process is eliminated from further consideration.

C.3.0 DEVELOPMENT OF REMOVAL ACTION ALTERNATIVES

The following demonstrated and potentially applicable technologies or process options for remediation of soils at Site 16 have been retained after screening of general response actions and technologies:

* No Action

* Containment Actions
  - Capping

* Removal and Disposal Actions
  - Excavation
  - On-Site Disposal
  - Class I Facility Disposal
  - Class II Facility Disposal

* In-Situ Treatment Actions
  - Solidification or Stabilization (Fixation)

* Ex Situ Treatment Actions
  - Soil Washing
  - Acid Washing
  - Solvent Extraction
  - Slurry-phase Bioremediation
  - Photolytic dehalogenation
  - GAC Adsorption
  - Clarification/Filtration

Since these technologies or process options do not individually satisfy the removal action objectives, they must be assembled into remedial alternatives. Certain technologies may necessarily be associated with other technologies. For example, depending on the concentration of constituents in the excavated soils and the applicability of LDRs, excavated soils may require treatment before disposal. The following specific removal action alternatives have been assembled for remediating soils at Site 16 at NAS Alameda based on the results of the technologies screening:

Alternative 1:	Excavation, Soil Washing and/or Solvent Washing
Alternative 2:	Excavation, Slurry-phase Bioremediation And Acid Washing
Alternative 3:	Soil Capping with Asphalt (No Excavation)
Alternative 4:	Excavation and Class I and II Off-Site Disposal
Alternative 5:	In-Situ Solidification or Stabilization (Fixation)
Alternative 6:	No Action

C.3.1 Description of Removal alternatives

Alternative 1: Excavation, Soil Washing and/or Solvent Washing

Alternative 1 includes removing soil containing PCB concentrations exceeding 1.0 mg/kg and total lead concentrations exceeding 300 mg/kg; separating PCBs from soil through on-site surfactant or solvent washing and removing leachable lead through on-site acid washing. The treated soil is backfilled into the excavation area. PCBs in wash water or solvent would be destroyed by photo-degradation. Lead removed from the metal solubilization process is disposed offsite.

Alternative 2: Excavation, Slurry-phase Bioremediation and Acid Washing

Alternative 2 includes removing soil containing PCBs exceeding 1.0 mg/kg and total lead concentrations exceeding 300 mg/kg; creating an aqueous slurry by mixing soil with water and other additives to increase the bioavailability. PCBs are biodegradable, and the soil then acid-washed to remove the lead. Treated soil is returned to the site. Lead contaminated residues are disposed of at a Class I facility.

Alternative 3: Soil Capping with Asphalt (No Excavation)

Alternative 3 involves the construction of multilayered caps and bottom liners designed to contain solid waste in place to prevent the migration of precipitation, or entry of vegetation or animals into the waste cell, and to collect and distribute any leachate generated by the waste.

Alternative 4: Excavation and Class I and II Off-Site Disposal

Alternative 4 includes removing soil containing PCB concentrations exceeding 1.0 mg/kg and total lead concentrations exceeding 300 mg/kg; and disposing of the excavated soil at a Class I facility, with or without treatment for lead and PCBs in soil through off-site solidification and stabilization. Soil containing only lead with concentrations exceeding 300 mg/kg will be disposed at a Class II facility.

Alternative 5: In-Situ Solidification or Stabilization (Fixation)

Alternative 5 involves the roto-tilling of contaminated soils with the addition of appropriate stabilizing chemicals to immobilize the PCBs and Lead. Thus, the process immobilizes leachable lead concentrations and PCBs in soil through on-site solidification or stabilization treatment. The stabilized soil is left in place and compacted.

Alternative 6: No Action

Alternative 6 involves natural attenuation of site contaminants and periodic inspection and monitoring of groundwater because it may be affected by existing vadose-zone soil contamination.

These six alternatives are evaluated in detail in the following section.

C.4.0 EVALUATION OF REMOVAL ACTION ALTERNATIVES

C.4.1 Evaluation Criteria

The identified removal action alternatives are evaluated based on three criteria: (1) effectiveness; (2) implementability; and (3) estimated costs.

C.4.1.1 Effectiveness

The effectiveness of an alternative refers to its ability to meet the cleanup objectives within the scope of the removal action. These objectives included: (1) overall protection of public health, community, and the environment; (2) ability to achieve the target cleanup levels; (3) reduction of toxicity, mobility, or volume through treatment; (4) long-term effectiveness and permanence; and (5) system reliability/maintainability. The preference of each treatment option over land disposal alternatives, where practicable treatment technologies are available, are also considered.

C.4.1.2 Implementability

The implementability criterion encompasses: (1) technical feasibility; (2) administrative feasibility of implementing an alternative; (3) availability of various services and materials required; and (4) regulatory agency and community acceptance. Technical feasibility was used to eliminate those alternatives that are clearly impractical at Site 16. Administrative feasibility pertains to those activities needed to coordinate with other offices and agencies such as permits and waivers.

C.4.1.3 Cost

Each removal action alternative is evaluated to determine its projected costs. The evaluation compares each alternative's capital and O&M costs. However, because each removal action alternative can be implemented in a relatively short period of time, any associated O&M costs are included in the capital cost. These costs are estimated using many sources and include vendor estimates, disposal facility fees, and estimates for similar projects.

C.4.2 Removal Action Alternatives

The preliminary screening resulted in six alternatives. The analysis of each removal action alternative consists of a description of the alternative, followed by an evaluation based on its relative effectiveness, implementability, and estimated cost. Table C-3 through C-8 presents a summary of the evaluation criteria for each alternative.

C.4.2.1 Alternative 1: Excavation, Soil Washing and/or Solvent Washing

<u>Description</u>

This alternative consists of soil excavation and on-site soil washing with metal solubilization to separate the PCBs and lead from the soil. The aqueous phase with high concentrations of the PCBs contaminants is either photolytically treated by UV oxidation or passed through beds of granular activated carbon (GAC) to remove the PCBs. The soil is further acid washed to solubilize the lead with subsequent precipitation. Precipitated lead is disposed of at a Class I landfill.

Excavation

For this site, excavation and hauling of soils would be achieved using conventional earthwork equipment such as a backhoe, bulldozers, and trucks. Few obstructions to excavation are likely during implementation of remedial activities at the Site 16 at NAS Alameda. Activities associated with soil excavation include the following:

* *Mobilization and Site Preparation.* Mobilization consists of all activities associated with mobilizing equipment of Site 16 and preparation of staging areas. Site preparation activities include removing the perforated runway plates, decommissioning utilities, removing necessary portions of site fencing, destroying monitoring wells located within the excavated area, setting up the on-site soil washing treatment system, and performing the preliminary earthwork necessary for excavation. Site preparation work also includes construction of a temporary chain-link fence with gates, around the proposed excavation area to prevent unauthorized access to the work area.

* *Excavation.* Excavation of contaminated soil is initiated using a backhoe or other earthwork equipment. Soil is removed from the excavation and temporarily stockpiled on polyethylene sheeting in an adjacent area. The soil is subsequently transferred to the designated area for on-site soil treatment activities. Excavated concrete or asphalt pavement is stockpiled separately, sampled, analyzed, and disposed of at a recycling or landfill facility.

* *Sampling.* Confirmation sampling includes screening and final confirmation sampling. Screening level sampling will be conducted after the initial excavation is accomplished to assess if additional excavation is required. On completing the excavation, final confirmation sampling will be conducted for verification. The final confirmation samples will assess the residual total petroleum hydrocarbon, PCB and lead concentrations in soil for RI/FS risk assessment purposes. It is assumed that screening level and final confirmation sampling includes collecting one sample per approximately 850 square feet of excavation.

* *Backfill and Compaction.* When the treatment is completed, the excavated area will be backfilled and compacted with the treated soil. All groundwater monitoring wells destroyed prior to excavation will be replaced. After the backfill and compaction and well installations are completed, the removal action for Site 16 will be complete.

Soil Washing with Surfactant or Solvent Extraction

Soil washing is accomplished by washing the soil with surfactant or using solvent to extract the contaminants. Contaminants sobbed onto soil particles are separated from soil in an aqueous-based system. The liquid-PCB containing phase is passed through either a GAC or a UV oxidizer to remove or breakdown the PCB. The liquid surfactant or solvent can be recycled through reflux. The slurry soil is further treated with acid solution to solubilize lead. Then suspension is dewatered by centrifugation or filter press. The soluble lead is precipitated chemically and packed in container for off-site landfill disposal. The dewatered soil will be tested for PCBs and lead and confirmed to meet treatment action levels. Soil containing lead at 130 mg/kg or less, or PCB's at 0.34 mg/kg will be stockpiled for replacement of the excavated soil.

On-Site Replacement

It is assumed that 50 percent of the excavated soil would require treatment for PCBs by soil washing and that all the excavated soil would require treatment for lead by acid washing before disposal. The quantity of leachable lead-contaminated soil requiring remediation will be verified prior to or during the removal action using the California WET test.

Effectiveness

By removing and treating Site 16 soil containing PCBs above 1.0 mg/kg and lead above 300 mg/kg, the toxicity, volume, and mobility of the contaminants in soil will be reduced. Soil washing has been proven to reduce PCB levels in soils to 1.0 mg/kg or less. Metal solubilization of lead and subsequent removal by precipitation has also been proven to remove lead. Backfilling the treated soil into the excavation therefore, eliminates the potential for any future releases of lead to groundwater. The short-term effectiveness is considered good because excavation, treatment, and backfilling of the soil can be completed within a relatively short period of time (6 to 8 months). Potential adverse impacts to site workers and the public and potential environmental impacts during implementation is minimal. However, these risks and impacts can be mitigated with the use of appropriate health and safety controls and site controls (for example, dust suppression by wetting soil). Implementation of this alternative provides an adequate degree of protection to both human health and the environment on a long-term basis.

Acid washing of contaminated soil enables remediation of lead to lower cleanup levels and reduces the toxicity, volume, and mobility of lead in soil to meet state and federal LDRs. Because leachable lead concentrations are reduced below the California state STLC, backfilling the treated soil into the excavation eliminates the potential for any future releases of lead to groundwater. Continued monitoring for lead leaching and conditions of the backfill would not be required. This alternative can be implemented within approximately 4 months and provides an adequate degree of protection to both human health and the environment on a long term basis.

Implementability

The excavation aspect of this alternative is implementable and site conditions are generally favorable. Soil washing and stabilization or acid washing processes are commonly applied technologies and could be easily implemented on-site. Site mobilization of the two treatment processes may require more operation area as opposed to one treatment system. On site disposal of treated soil is anticipated to be acceptable to the regulatory agencies and the community because this alternative reduces contaminant toxicity, volume, and mobility. In addition, no air emissions are produced using this treatment process. Overall, this alternative may not be difficult to implement.

Cost

On-site soil washing with photolysis or GAC adsorption and metal solubilization are generally capital-cost intensive. The two aspects of Alternative 1 considered are: (A) excavation, soil washing with GAC, metal solubilization and on-site disposal; and (B) excavation, soil washing with UV oxidation (photolysis), metal solubilization, and on-site disposal. The estimated capital cost for implementing both alternatives is $1.20 million. Table C-9 presents details of the associated costs. Costs for monitoring groundwater quality on a routine basis are assumed to be included in the ongoing NAS Alameda RI/FS.

C.4.2.2 Alternative 2: Excavation, Slurry-phase Bioremediation and Acid Washing

Description

This alternative consists of soil excavation and on-site bio-slurry remediation of soil by using micro organic additives and nutrients to enhance biodegradation of PCBs from soil. Lead is removed by acid washing, then separated for landfill disposal. Treated soils would be sampled and analyzed to confirm that federal and state LDRs are met prior to replacement on site as backfill for the excavated area. Excavation, on-site treatment, and on-site disposal details are described below.

Excavation

Excavation activities for this alternative would be as described under Alternative 1.

On-Site Slurry-Phase Bioremediation

Bio-slurry remediation involves the use of micro-organisms to biodegrade PCBs in soil in an aqueous slurry phase. The aqueous slurry is created by mixing contaminated soil with water to form a homogenous phase. The water may include a basic surfactant, pH adjustment, or chelating agent to help remove the organic contaminants sobbed onto soil particles from soil in the aqueous-based system. The effectiveness of the treatment process, especially for Aroclor 1260, the predominant PCB at the site, will require that a treatability study be conducted prior to field work to determine the feasibility of degrading Aroclor 1260 within 6 months to 1 year. The objectives of the treatability study will be to (1) evaluate effectiveness of this treatment process in meeting the treatment goal; (2) evaluate microbes, surfactants, pH adjustment, or chelating agents; (3) evaluate the optimum concentration of additives used and bioremediation time; and (4) estimate the final PCB concentration of treated soil. On-site locations will be needed to stockpile and treat soil. Posttreatment of fine soil particles and wash water is assumed to be required.

The PCBs bioremediation will be followed by acid washing to remove lead. This process involves the solubilization of lead through pH adjustment and subsequent precipitation of the lead from the resulting solution. The precipitated lead is disposed at a Class I landfill.

On-Site Replacement

Replacement of soil on site consists of backfilling the biotreated soil into the excavation. On-site replacement must be acceptable to regulatory agencies and the community, in addition to meeting state and federal LDRs. Disposal on site may require installing additional groundwater monitoring wells to monitor the potential leaching of the treated backfill. Regulatory agencies will not allow treated soil to be used as backfill unless it passes the California WET test as discussed in Section 2.5. Obtaining regulatory and community acceptance of on-site disposal of treated soil is generally good if treatment standards are met.

Effectiveness

By removing and treating Site 16 soil with high PCB and lead concentrations, the volume of contaminated soil is reduced. This process offers the potential for recovery of lead, however, biodegradation of PCBs from soil may be less effective. The process becomes even more less-effective for Aroclor 1260 and if the soil contains high proportions of fine grained fractions. The ability of bio-slurry remediation to meet proposed cleanup levels and state and federal LDRs for backfilling is therefore uncertain. In addition, lead would be highly concentrated in the resulting residue to be disposed off site. Short-term effectiveness is considered high because the excavation, treatment, and backfilling of the soil can be completed within a relatively short period of time. Potential adverse exposure to site workers and the public and potential environmental impacts during implementation is minimal. However, health effects and occupational risk can be mitigated with the use of appropriate health and safety controls (for example, personal protective equipment) and site controls (for example, dust suppression by wetting soil). Implementation of this alternative will provide a high degree of protection to both human health and the environment on a long-term basis. Because the toxicity of the treated soil is removed, the liability associated with replacement on site for Alternative 2 is minimal.

Implementability

Excavation of contaminated soil is implementable. In addition, site characteristics are generally favorable for excavation activities. Although the perforated runway plates need to be removed, the majority of the site is bare ground with little or no vegetation. Mobilizing a bio-slurry system on site is implementable, but requires obtaining a regulatory temporary treatment unit (TTU) permit. Soil disposal on site is generally acceptable to the regulatory agencies and the community if treated to below state and federal LDRs. However, as discussed above, implementing Alternative 2 to meet cleanup requirements for PCBs may be difficult.

Cost

On-site bioremediation and metal solubilization processes are generally capital-cost intensive. Table C-9 presents the estimated capital cost for implementing Alternative 2. The estimated capital cost includes treatment system O&M and is approximately $1.02 million. However, costs for monitoring groundwater quality on a routing basis are assumed to be included in the ongoing NAS Alameda RI/FS.

C.4.2.3 Alternative 3: Site Capping with Asphalt (No Excavation)

Description

This alternative does not require soil excavation from Site 16 at NAS Alameda. The alternative would require the construction of multilayered maps and top liners designed to contain solid waste in place to prevent the migration of precipitation, or entry of vegetation or animals into the waste cell.

Excavation

Excavation is not required for this alternative.

Effectiveness

By capping Site 16 soil containing PCBs above 1.0 mg/kg and lead above 300 mg/kg, leaching of the contaminants will be mitigated. However, because soil is not excavated, the long-term potential for any future releases to groundwater is not effectively eliminated. The short-term effectiveness of implementing Alternative 3 is considered low because the hot spots are not removed. Implementation of this alternative will reduce the long-term risk to human health, but not the environment.

Implementability

Capping activities for this alternative are implementable. Standard mechanical equipment are readily available. However, regulatory agency and community acceptance is unlikely. It may restrict future use of the site.

Cost

Implementing Alternative 5 requires minimal capital and O&M expenditures. No excavation is required. The estimated cost for implementing Alternative 3 is $0.38 million as presented on Table C-9. On-site groundwater monitoring costs are considered to be included in the ongoing NAS Alameda RI/FS.

C.4.2.4 Alternative 4: Excavation and Class I and II Off Site Disposal

Description

This alternative requires excavation of the soil and transportation of the removed soils to an off-site Class I and II facility with or without pretreatment.

Excavation

Excavation activities for this alternative are as described in Alternative 2, except that soil is removed from the excavation area, temporarily stockpiled, then transferred to an area designated for loading onto trucks for transport to a disposal facility. Soils excavated from the areas contaminated with both PCBs and lead will be separately stockpiled. Soils with PCBs and lead will be disposed at a Class I facility, while soils with only lead will be disposed at a Class II facility.

Class I or II Disposal

Excavated soil containing PCB above 1.0 ppm (1,000 cubic yards) will be transported and disposed of off-site at a permitted Class I treatment and disposal facility. Soils containing only lead below the 1,000 ppm TTLC may be disposed of at a class II landfill. Some pretreatment of the contaminated soils may be required to meet state and federal LDRs depending on contaminant concentrations. Disposal of soil is subjected to LDRs if it contains lead at concentration exceeding the TCLP of 5.0 mg/L. According to a Class I facility representative, soil containing PCBs would most likely be disposed of in a TSCA-permitted landfill. Transportation to the off-site facility would require over 100 trips, which introduces a potential risk to the community from accidental release. On-site locations would be required for temporary stockpiling of soil before transporting to the Class I facility. It is assumed that the excavated soil is to be disposed of at the Class I facility with or without pretreatment by the Class I facility.

Effectiveness

By moving soil with elevated PCB, and lead concentrations from the site to a facility that will physically contain it, the mobility of the contaminants is reduced. The Class I treatment and disposal facility and Class II disposal facilities would ensure that stringent LDRs are met with or without waste pretreatment, thus attaining long-term effectiveness or permanence. However, the Navy could ultimately be liable for future leaks at the landfill. In addition, by backfilling the excavation with imported clean material, the potential for future releases to groundwater at Site 16 would be permanently eliminated. This alternative would achieve the removal action objectives for Site 16 over a short period of time and would be effective over the short term; however, the Navy would increase its liability by disposing its waste in landfill. In addition, federal guidance states that off-site transport and disposal of hazardous substances or contaminated material is the least preferred remedial action alternative where practicable treatment technologies exist.

Implementability

The excavation activities for this alternative are implementable, as discussed under Alternative 2. Class I and II landfill requires development of a waste profile for incoming waste streams. Based on the results of the profile and LDRs, pretreatment for particular compounds may or may not be required prior to disposal. Class I facility personnel indicate that, based on the available Site 16 analytical data, soil would be accepted for disposal with pretreatment for elevated concentrations of the lead only. Facility personnel indicated that the pretreatment process for lead would also effectively treat PCBs. It is assumed that after completion of the pretreatment process for lead, no further post-treatment is required for land disposal. Liability risks associated with soil disposal at a Class I and II facilities are potentially high. Disposal of soil at a landfills will be difficult to implement as a result of the administrative problems.

Cost

Implementing this alternative requires no capital investment and, once disposal is completed, no O&M costs. The developed costs for Alternative 4 are for soil excavation and Class I and II disposal without treatment. Details of the associated costs are provided on Table C-9. The estimated cost for Alternative 4 is $0.72 million. Costs for groundwater monitoring at Site 16 are considered to be included in the ongoing NAS Alameda RI/FS.

C.4.2.5 Alternative 5: In-Situ Solidification or Stabiliaztion (Fixation)

Description

This alternative requires tilling of the soil and blending with chemical stabilizers to ensure that contaminants are immobilized long term.

Excavation

Excavation is not required for this alternative.

On-Site Solidification or Stabilization (Fixation)

The purpose of solidification or stabilization is to immobilize the lead and PCBs in soil by mixing the soil with chemical agents. This process is a commonly used method for treating lead in soil. However, the necessity of solidification or stabilization to immobilize PCBs is questionable since PCBs are highly immobile except by soil erosion. The effectiveness of soil treatment for lead would require verification by a treatability study that should be performed before field work begins. The objective of the treatability study would be to evaluate (1) the effectiveness of this treatment process in meeting the soluble lead treatment goal; (2) solidification or stabilization agents; (3) the optimum concentration of agents used and curing time; and (4) the final condition of treated soil and volume increase.

Effectiveness

The mobility of the contaminants in soil is reduced by removing and treating Site 16 soil containing PCBs above 1.0 mg/kg and lead above 300 mg/kg. Solidification or stabilization processes have demonstrated capability to reduce the mobility of contaminated waste by greater than 95 percent. However, in-situ fixation reduces but does not eliminate the potential for any future release to groundwater. Continued monitoring of leaching and conditions of the soil is required. The short-term effectiveness is considered high because the in-situ fixation of the soil can be completed within a relatively short period of time. Potential adverse exposure to site workers and the public and potential environmental impacts during implementation is minimal. However, these occupational risks and impacts can be mitigated with the use of appropriate health and safety controls and site controls. Environmental conditions may affect the long-term immobilization of the contaminants, and may result in the long-term to potential environmental and public health impacts.

Acid washing of contaminated soil enables remediation of lead to lower cleanup levels and reduces the toxicity, volume, and mobility of lead in soil to meet state and federal LDRs. Because leachable lead concentrations are reduced below the California state STLC, backfilling the treated soil into the excavation eliminates the potential for any future releases of lead to groundwater. Continued monitoring for lead leaching and conditions of the backfill may not be required. This alternative can be implemented within approximately 4 months and provides an adequate degree of protection to both human health and the environment on a long term basis.

Implementability

This alternative is relatively easy to implement. Necessary construction equipment are readily available. Fixation process however, would require permitting. Effectiveness of the in-situ treatment requires verification through a treatability study. Regulatory and community acceptance may be difficult.

Cost

In-situ soil fixation is generally not capital-cost intensive. The estimated capital cost is approximately $0.79 million. However, costs for monitoring groundwater quality on a routing basis are assumed to be included in the ongoing NAS Alameda RI/FS.

C.4.2.6 Alternative 6: No Action

Description

This removal action alternative is retained for analysis to provide a basis for comparison with other alternatives. For this alternative, no remedial activities for soil would be implemented at Site 16 at NAS Alameda. The no-action alternative would include monitoring of on-site ambient air and nearby downgradient wells for PCBs and lead. However, because monitoring will be performed as part of the current NAS Alameda RI/FS, the estimated cost for monitoring is not included in this alternative.

Effectiveness

Removal action objectives would not be achieved through naturally occurring processes, such as biodegradation. Natural degradation of PCBs through biological process is unlikely because this process is dependent on numerous factors (for example, oxygen, temperature, pH, and nutrients) and because degradation of highly chlorinated PCBs, Aroclor 1254 (five chlorines) and 1260 (six chlorines), is difficult and would require several years. Biodegradation is not effective for lead, which may be toxic to microbes. Over several years PCBs may migrate and lead may leach from soil into groundwater due to the lack of containment of chemicals in the vadose-zone soil. Therefore, no reduction of toxicity, mobility, or volume of PCBs and lead would be achieved. The no-action alternative would not be effective in reducing risk to public health and the environment in the short term and would not offer long-term effectiveness and permanence.

Implementability

The no-action alternative is easily implementable. However, regulatory agency and community acceptance is doubtful.

Cost

There are no capital or O&M costs associated with the no-action alternative. Groundwater quality would be monitored periodically to ensure the long-term effectiveness of the no-action alternative. As discussed earlier, these costs are assumed to be included in the ongoing NAS Alameda RI/FS.

C.5.0 COMPARATIVE ANALYSIS OF REMOVAL ACTION ALTERNATIVES

This section presents a comparative analysis of the six alternatives analyzed in Section 4. The alternatives are compared against each other in order to evaluate the relative performance of each alternative in relation to each of the criteria. The criteria used in this comparison are the same as in Section 4. To facilitate this analysis, a relative ranking method is used, in addition to the qualitative analysis previously described. Table C-9 shows a summary of the comparative analysis for the six removal action alternatives.

Table C-10 summarizes the relative ranking order for each alternative with respect to effectiveness, implementability, and cost. Details of the comparative analysis of alternatives are discussed below.

Effectiveness

Six removal action alternatives (1-6) were assembled for detailed analysis. As shown on Table C-9, Alternative 2, Alternative 1, and Alternative 4 are similar in terms of the level of protection to human health and the environment. However, the effectiveness of Slurry-Phase Bioremediation is not proven and thus may not provide adequate long-term environmental and public health protection. Alternative 2 is therefore eliminated. Alternative 6 does not provide adequate short-term or long-term effectiveness or permanence at Site 16 because contaminants are not removed. Therefore, No Action is eliminated. Alternative 5 and Alternative 3 are eliminated because they do not provide adequate long-term effectiveness and permanence at the site. Achieving long-term effectiveness and permanence is of great importance in reducing potential future liability risks to the Navy. Additionally, the removal action objections and goal of unrestricted use reinforce the importance of long-term effectiveness and permanence.

Alternatives 1 and 2 are effective and satisfy the identified removal action objectives for Site 16. These two remaining alternatives are proven to effectively treat PCBs and lead in soil, although a treatability study would be required to determine the optimal surfactants, solvents, acids, reagents, and system operation parameters. These alternatives would require an estimated 30 days for system mobilization and demobilization, and 60 to 90 days for soil treatment.

Implementability

Regulatory permits must be obtained for operating an on-site treatment system. Implementing Alternative 1 would meet PCB and lead cleanup levels. This alternative provides adequate long-term protection for either human health or the environment. Landfill disposal is potentially less expensive to implement and would require a shorter period of time to complete than Alternative 1. However, the CERCLA requires that the transport and disposal of hazardous substances or contaminated materials off-site without treatment should be the least favored alternative remedial action. Therefore Alternative 4 was eliminated because treatment approaches are preferred over landfill disposal approaches.

Overall Selection

Cost was not a consideration in the overall selection of the preferred alternative. Alternative 1 is the preferred alternative for remediation of soil at Site 16 based on the evaluation. Alternative 1 Excavation, Soil washing, and/or Solvent Extraction is the most implementable alternative for treatment and disposal of Site 16 soil with elevated PCB and lead concentrations. This alternative mitigates the risk to human health and the environment and reduces the potential impacts of soil contaminants on the groundwater by treating soil to meet proposed cleanup levels (less than 1.0 mg/kg for PCBs and less than 300 mg/kg for lead) and state and federal LDRs. Therefore, implementing Alternative 1 meets the removal action objectives identified in this EE/CA RAW.

Table C-1

GENERAL REMOVAL ACTION AND TECHNOLOGY SCREENING SUMMARY
SITE 16 - CANS - 2 AREA

General Response Action/Process	Remedial Technology /Process	Effectiveness	Implementability	Estimate Cost	Initial Screening Decision	Comments
No Action	No Action	Low	Good	Low	Consider	Serves as baseline, contaminants remain indefinitely
Institutional Controls	Deed Restrictions	Low	Good	Low	Eliminate	Minimal protection to human health and the
	Fencing	Low	Good	Low	Eliminate	environment, not permanent soil remediation solution
Containment Actions	Capping	Low	Good	Low	Consider	These actions prevent exposure and further migration
	Vertical Barriers	Low	Moderate	Moderate	Eliminate	however, they provide only limited protection to
	Horizontal Barriers	Low	Moderate	Moderate	Eliminate	human health and the environment and limit future
	Surface Controls	Low	Good	Low	Eliminate	land use
Removal/Disposal Actions	Excavation	High	Good	Moderate	Consider	Effective, easy to implement
	On-Site Backfill	Moderate	Moderate	Low	Consider	Community resistance
	Class I Disposal	High	Good	High	Consider	Can pretreat for lead and PCBs prior to disposal
	Class II Disposal	Moderate	Good	Moderate	Consider	Case by case acceptance of waste
	Class III Disposal	Low	Difficult	Low	Eliminate	Soils do not meet stringent facility acceptance criteria
	Recycler	Low	Difficult	Low	Eliminate	Lead and PCB concentrations too high for acceptance
In Situ Action	Solidification/Stabilization	Moderate	Moderate	Low	Consider	Immobilizes lead may immobilize PCBs
	Aeroble Bioremediation	Low	Moderate	Moderate	Eliminate	Not proven effective for all PCBs, not effective for lead
	Anaerobic Bioremediation	Low	Difficult	Moderate	Eliminate	Not feasible in shallow soil (<2 ft bgs) nor for lead
	Vitrification	High	Difficult	Very High	Eliminate	Complex technology, very high costs
Ex Situ Actions	Soil Washing	Moderate	Moderate	Moderate	Consider	Effective for removing lead and potential PCBs
	Acid Washing	Moderate	Moderate	Moderate	Consider	Effective for removing lead, not effective for PCBs
	Solvent Extraction	Moderate	Moderate	Moderate	Consider	Effective for removing PCBs and potentially lead
	Slurry-phase Bioremediation	Moderate	Moderate	Moderate	Consider	Effective for removing PCBs, not effective for lead
	Controlled Solid-phase Biotreatment	Low	Difficult	Low	Eliminate	Not effective for lead, lead toxic to microbes
	White-rot Fungus	Low	Difficult	Moderate	Eliminate	Not proven technology, not effective for lead
	Solidification/Stabilization	Moderate	Moderate	Moderate	Eliminate	In-Situ more cost effective
	Chemical Dechlorination	Low	Difficult	High	Eliminate	Effective for PCBs, not effective for lead
	Ultrasonic Detoxification	Low	Difficult	High	Eliminate	Not proven technology, not effective for lead
	Incineration	Moderate	Good	High	Eliminate	Proven for PCBs, but not lead, very high costs
	Thermal Desorption	Moderate	Difficult	Moderate	Eliminate	Proven for PCBs not lead, difficult for site-specific soil
	Pyroplasmic	Low	Difficult	High	Eliminate	Not effective for solid wastes or lead
	Photo Dehalogenation	High	Good	Moderate	Consider	Effective for PCBs, not effective for lead

Date: 07/10/95

07/10/95

NAVAL AIR STATION, ALAMEDA
SITE 16 - CANS-2 AREA
WASTE TREATMENT PROCESS SCREENING

TABLE C-2

bj. #: 95A1601

General Response Action	Treatment Process	Contaminant Treated: PCB	Contaminant Treated: Metal
No Action	Do Nothing		
Contaminment Actions	Capping	●	●
	Encapsulation	●	●
In-Situ Treatment Actions	Electrolytic Recovery Techniques		●
	Air Stripping & Steam Stripping	●	
	Evaporation		
	Physical and Chemical Fixation	●	●
	Aerobic Process	●	
	Anaerobic digestion		
	Enzymatic Treatment		
	Thermal Desorption	●	
	Detoxification	●	
Ex-Situ Treatment Actions	Activated Carbon Adsorption	●	
	Distillation		
	Electrolytica Recovery Techniques		●
	Hydrolysis		
	Ion Exchange		●
	Solvent Extraction	●	
	Membrane Separation Technolgy		
	Air Stripping & Steam Stripping	●	
	Freeze Crystallization		
	Filtration and Separation	●	●
	Chemical Precipitatoin		●
	Thin-film Evaporation		

General Response Action	Treatment Process	Contaminant Treated: PCB	Contaminant Treated: Metal
Institutional Control Actions	Natural Attenuation	●	
Removal & Disposal Actions	Excavation & Land Disposal	●	●
Ex-Situ Treatment Actions	Dehalogenation	●	
	Ozonation		
	Evaporation		
	Physical & Chemical Fixation	●	●
	Liquid-injection Incineration		
	Rotary Kilns Incineration	●	
	Fluidzed Bed Thermal Oxidation		
	Wet Oxidation		
	Pyrolysis	●	
	Supercritical Fluid Extraction		
	Plasma System		
	Incineration	●	
	Catalytic Incineration		
	Aerobic Process	●	
	Surfactant Washing	●	
	Abaerobic Digestion		
	Enzymatic Treatment		
	Photolysis	●	
	Chemical Oxidation & Reduction		
	Termal Desorpation	●	
	Detoxification	●	

References:

EPA Document, 1993; Remediation Technologies Screening Matrix and Reference Guide, Version I.

2. DHS/TSCD Third Biennial Report, 1986; Alternative Technologies for Recycling and Treatment of Hazardous Wastes

3. Freeman, Harry M.; Standard Handbook of Hazardous Waste Treatment and Disposal

Table C-3
Alternative 1: Excavation, Soil Washing And/or Solvent Extraction Detailed Evaluation

	EVALUATION CRITERIA	EVALUATION
EFFECTIVENESS	Overall Protection	Soil washing with water or solvent has been proven to reduce PCB levels in soils to 1.0 mg/kg or less. Metal solubilization of lead and subsequent removal by precipitation have also been proven to remove lead. Backfilling the treated soil into the excavation therefore eliminates the potential for any future releases of lead to groundwater. Potential adverse impacts to site workers and the public and potential environmental impacts during implementation is minimal. Soil Excavation poses a potential health and safety risk to site workers through skin contact and sir emissions. Personal protective equipment, at a level commensurate with the contaminants involved, is normally required during excavation operations.
	Compliance with ARARs	Potential ARARs are met to the extent practicable by removing all contaminants and residual PCB, Pb soil concentration that is less than action level.
	Long-term Effectiveness and Permanence	Implementation of this alternative provides an adequate degree of protection to both human health and the environment on a long-term basis.
	Reduction in Toxicity, Mobility, or Volume through Treatment	This alternative provides some degree of reduction in contaminant mobility through excavation. However, metal mobility of post-treatmetn soil may increase form acid solubilization.
	System Reliability/Maintainability	This alternative is demonstrably reliable for both PCbs and Pb.
IMPLEMENTABILITY	Technical Feasibility	The excavation aspect of this alternative is implementable and site conditions are generally favorable. Soil washing and acid washing are commonly applied technologies that could be easily implemented on-site.
	Administrative Feasibility	Site mobilization and setting up of this alternative may require more space for operation. Permits would be required for discharge and treatment.
	Availability of Services and Materials	Equipment and skilled or knowledgeable personnel required for implementation are readily available. Personnel specifically trained in soil washing or solvent extraction operations would be required on-site. Water would be required on-site for contamination control (e.g., dust suppression) and treatment activities. Should water not be readily available (e.g., nearby hydrant), water would have to be brought in by truck. Other resources, such as electricity are available on-site, whereas, telephone, and fuel would be provided by mobile sources. Off-site disposal capacity and analytical capabilities are readily available.
	Regulatory Agency/ Community Acceptance	On-site disposal of treated soil is anticipated to be acceptable to the regulatory agencies and the community because this alternative reduces contaminant toxicity, volume, and mobility. In addition, no air emissions are produced using this treatment process.
COST	Estimated Cost	The cost of this alternative is estimated at $1,200,000.

Table C-4
Alternative 2: Excavation, Slurry-Phase Bioremediation, And Acid Washing Detailed Evaluation

	EVALUATION CRITERIA	EVALUATION
EFFECTIVENESS	Overall Protection	Excavation of contaminants from the site ensures overall protection of human health and the environment. The contaminants are degraded through bioremediation in slurry phase. Treated soil is returned to the excavated area. This alternative exceeds the basic objectives of overall protection. On-site treatment increases the potential for site worker and public exposure to contaminants; however, these risks can be mitigated. Implementation of appropriate health and safety procedures and use of standard contamination control practices (e.g., dust suppression, runon/runoff control) minimize potential exposure of site workers and the public. Because treated soils are returned to the excavation, the need for off-site borrow material to backfill the excavation in minimal.
	Compliance with ARARs	Potential ARARs are met to the extent practicable by removing all contaminants and residual soil PB and PCBs concentrations are less than action levels.
	Long-term Effectiveness and Permanence	This alternative is effective over the long-term since PCBs are permanently destroyed.
	Reduction in Toxicity, Mobility, or Volume through Treatment	The slurry-phase bioremediation of subsurface soils reduces the level of contaminants below the regulatory action levels. Excavated material requiring disposal is limited to the lead removed during remediation.
	System Reliability/Maintainability	This alternative may only be applicable to some compounds within the contaminant group. Contaminant loading rates can also be very slow.
IMPLEMENTABILITY	Technical Feasibility	Slurry-phase bioremediation is an emerging technology for remediation of PCB-Contaminated soil. The process, however has not been demonstrated to EPA's satifaction. Althought two demonstrated bio-remediation systems were listed in SITE Program, no technology currently exists that is capable of biodegrading PCBs on a large scale. Temporary treatment facility is necessary at the site. Since contaminated soil is removed, treated and returned to the excavation, the action is consistent with any potential final action taken at the site.
	Administrative Feasibility	Permits would not be necessary to implement the action. Coordination with Naval Air Station Alameda security may be required since fencing near the site may have to be removed during excavation. Consideration would be given to traffic control measures, as material would need to be transported offbase using Perimeter Road. Additional access restrictions would need to be implemented at the temporary treatment facility.
	Availability of Services and Materials	Equipment and knowledgeable personnel required for implementation are readily available. Personnel specifically trained in ex situ bioremediation operations would be required on-site. Water would be required on-site for contamination control (e.g., dust suppression) and treatment activities. Should water not be readily available (e.g., nearby hydrant), water would have to be brought in by truck. Other resources, such as electricity, telephone, and fuel for equipment would be provided by temporary/mobile sources. Off-site disposal capacity and analytical capabilities and readily available.
	Regulatory Agency/ Community Acceptance	This alternative meets the statutory preference for treatment by effectively treating the excavated material. This alternative employs a reliable, cost-effective technology which utilizes treatment to mitigate threats posed by contaminants at site 16. This alternative is acceptable both to regulatory agencies and to the public.
COST	Estimated Cost	The cost of this alternative is estimated at $1,020,000.

Table C-5
Alternative 3: Soil Capping with Asphalt (No Excavation)
Detailed Evaluation

	EVALUATION CRITERIA	EVALUATION
EFFECTIVENESS	Overall Protection	Site 16 soil containing PCBs above 1.0 ppm and lead above 300 ppm would be capped. However, because soil is not excavated, the long-term potential for future releases to groundwater is not effectively eliminated. Implementation of appropriate health and safety procedures and use of standard contamination control practices (e.g., dust suppression, runon/runoff control) minimizes potential exposure of site workers and the public.
	Compliance with ARARs	Potential ARARs are met to the extent practicable by containing all contaminants which exceed action levels.
	Long-term Effectiveness and Permanence	The long-term effectiveness of implementing this alternative is considered low because the hot spots are not removed. Implementation of this alternative will reduce the long-term risk to human health, but not to the environment.
	Reduction in Toxicity, Mobility, or Volume through Treatment	The capping of subsurface soils eliminates the excavation of soil requiring disposal. Although contaminants are not destroyed, capping ensures negligible leaching of the contaminants to groundwater.
	System Reliability/Maintainability	Capping with asphalt is relatively simple and uses readily available equipment. This alternative is reliable to the extent that it reduces risk to human health but not to the environment.
IMPLEMENTABILITY	Technical Feasibility	Technically feasible.
	Administrative Feasibility	This alternative is administratively not implementable since public and regulatory agency acceptance may be difficult. This alternative also restricts future land use. Long-term liability is associated with land reuse.
	Availability of Services and Materials	Equipment and knowledgeable personnel required for implementation are readily available. Personnel specifically trained in soil capping operations would be required on-site. Water would be required on-site for contamination control (e.g., dust suppression) and treatment activities. Should water not be readily available (e.g., nearby hydrant), water would have to be brought in by truck. Other resources, such as electricity, telephone, and fuel for equipment would be provided by temporary/mobile sources. Off-site disposal capacity and analytical capabilities are readily available.
	Regulatory Agency/ Community Acceptance	Acceptance not likely by either regulatory agencies or the public.
COST	Estimated Cost	The cost of this alternative is estimated at $380,000.

Table C-6
Alternative 4: Excavation and Class I and II Off-Site Disposal
Detailed Evaluation

EVALUATION CRITERIA		EVALUATION
EFFECTIVENESS	Overall Protection	Removal of contaminants from the site ensures overall protection of both human health and the environment. The contaminated soils are transferred to a managed disposal facility. This alternative exceeds the basic objectives of overall protection. This alternative would achieve the removal action objectives for Site 16 over the short term; however, the Navy would increase its liability by disposing of its waste in landfill. Excavation poses a potential health and safety risk to site workers through skin contact and air emissions. Personal protective equipment, at a level commensurate with the contaminants involved, is normally required during excavation operations. Transportation to the off-site facility introduces a potential risk to the community via accidental release.
	Compliance with ARARs	Potential ARARs are met to the extent practicable by removing all contaminated soils which exceed action levels.
	Long-term Effectiveness and Permanence	By moving soil with elevated PCB and lead concentrations from the site to a facility that will physically contain it, the mobility of the contaminants at the site itself is reduced. The Class I treatment and disposal facility and Class II disposal facility would ensure that stringent LDRs are met with or without waste pretreatment, thus attaining long-term effectiveness and permanence.
	Reduction in Toxicity, Mobility, or Volume through Treatment	The excavation and disposal of subsurface soils does not provide any reduction in the volume of excavated material requiring disposal. Disposal of surface soils in a managed disposal facility provides some degree of reduction in contaminant mobility and eliminates exposure pathways which in turn reduces the realized toxicity of contaminants.
	System Reliability/Maintainability	System is well established and reliable, requiring only minimum maintenance.
IMPLEMENTABILITY	Technical Feasibility	Excavation and disposal is a well demonstrated removal action which uses standard construction practices. The action is reliable and readily implementable. Since contaminants are removed from the site, the action is consistent with any potential final action taken at the site.
	Administrative Feasibility	Permits would not be necessary to implement the action; however, coordination with Naval Air Station Alameda security may be required since fencing near the site may have to be removed during excavation. Consideration would be given to traffic control measures, as material would need to be transported offbase using Perimeter Road.
	Availability of Services and Materials	Equipment and knowledgeable personnel required for implementation are readily available. Water would be required on-site for contamination control (e.g., dust suppression) and treatment activities. Should water not be readily available (e.g., nearby hydrant), water would have to be brought in by truck. Other resources, such as electricity, telephone, and fuel for equipment would be provided by temporary/mobile sources. Off-site disposal capacity and analytical capabilities are readily available.
	Regulatory Agency/ Community Acceptance	This alternative does not meet the statutory preference for treatment; however, it offers timely mitigation of threats posed by contaminants at Site 16. This alternative can be accomplished in a short period of time.
COST	Estimated Cost	The cost of this alternative is estimated at $720,000.

Table C-7
Alternative 5: In-Situ Solidification or Stabilization (Fixation) Detailed Evaluation

	EVALUATION CRITERIA	EVALUATION
EFFECTIVENESS	Overall Protection	Contaminants are not removed from the site or destroyed. Fixation (solidification or stabilization) of the soil reduces mobility of the contaminants. Potential for future releases of contaminants is reduced but not eliminated. Potential adverse exposure to site workers and the public and potential environmental impacts during implementation are minimal. These occupational risks and impacts can be further mitigated with the use of appropriate health and safety controls (for example, PPE) and site controls (for example, dust suppression by wetting soil).
	Compliance with ARARs	Potential ARARs may be met fixation of all contaminated soils which exceed action levels.
	Long-term Effectiveness and Permanence	Environmental conditions may affect the long-term immobilization of the contaminants and result in long-term potential environmental and public health impacts. Depending on the original contaminants and the chemical reactions that take place in the in-situ solidification/stabilization process, the resultant stabilized mass may still have to be treated as a hazardous waste. Continued monitoring of leaching and conditions of the soil are required.
	Reduction in Toxicity, Mobility, or Volume through Treatment	Solidification or stabilization processes have demonstrated a capacity to reduce the mobility of contaminated waste by greater than 95 percent. Some processes may result in a significant increase in the volume of the soil (up to double the original volume).
	System Reliability/Maintainability	This alternative has limited effectiveness against halogenated and non-halogenated semivolatile organic compounds.
IMPLEMENTABILITY	Technical Feasibility	This alternative is readily implementable. Necessary construction equipment is readily available. In situ solidification/stabilization is relatively simple, uses readily available equipment, and has high throughput rates compared to other technologies.
	Administrative Feasibility	Permits would be required to implement this action.
	Availability of Services and Materials	Equipment and knowledgeable personnel required for implementation are readily available. Water would be required on-site for contamination control (e.g., dust suppression) and treatment activities. Should water not be readily available (e.g., nearby hydrant), water would have to be brought in by truck. Other resources, such as electricity, telephone, and fuel for equipment would be provided by temporary/mobile sources. Off-site disposal capacity and analytical capabilities are readily available.
	Regulatory Agency/ Community Acceptance	Regulatory acceptance may be difficult. Community acceptance may be difficult.
COST	Estimated Cost	The cost of this alternative is estimated at $790,000.

Table C-8
Alternative 6: No Action
Detailed Evaluation

	EVALUATION CRITERIA	EVALUATION
EFFECTIVENESS	Overall Protection	No action involves no excavation or handling materials. Therefore, site workers require no protective equipment and there is no risk to the community from excavation and transportation of contaminated materials. There are potential risks, however, from migration of contaminants to areas where groundwater is being used.
	Compliance with ARARs	Potential ARARs are met to the extent practicable by removing all contaminants which exceed action levels.
	Long-term Effectiveness and Permanence	Does not comply with ARARs. Since contaminants are not removed from the soil, future migration of contaminants is likely.
	Reduction in Toxicity, Mobility, or Volume through Treatment	No treatment is involved. Thus, there is no reduction in toxicity, mobility or volume of contaminants at the site.
	System Reliability/Maintainability	No treatment system is required.
IMPLEMENTABILITY	Technical Feasibility	Technically feasible.
	Administrative Feasibility	Not administratively feasible since the alternative is not acceptable to regulatory agencies and is only used for comparative purpose.
	Availability of Services and Materials	No services and materials are required to implement this alternative.
	Regulatory Agency/ Community Acceptance	Acceptance to regulatory agencies is doubtful.
COST	Estimated Cost	No cost has been associated with this alternative.

Table C-9

REMEDIAL ALTERNATIVES COMPARISON SUMMARY
SITE 16 - CANS - 2 AREA

Remedial Alternative	Effectiveness	Implementability	Estimated Total Capital Cost
Alternative 1 Excavation, Soil Washing, and/or Solvent Extraction	Provides adequate protection to human health and the environment. Removal action objectives are likely to be achieved with this alternative. PCBs and lead are removed from soil. Therefore, treated soil disposal on site should not affect the groundwater over the long term.	Technically and administratively implementable. On-site soil washing, photolysis and acid washing would require permitting. A treatability study would assess effectiveness. Treatment work requires secondary treatment or disposal. Regulatory and community acceptance of on-site disposal will be required. Backfill of acid-washed soil would be treated.	$1,200,000
Alternative 2 Excavation, Slurry-phase Bioremediation, and Acid Washing	Provides adequate protection to human health and the environment. Removal action objective are likely to be achieved with this alternative. However Bio-slurry remediation may not be effective for removing PCBs. Treated soil is backfilled may affect the groundwater over a long period of time.	May be relatively difficult to implement. On-site bioremediation would require permitting. Effectiveness of treatment requires verification by treatability study. By-products may require secondary treatment or disposal. Regulatory and community acceptance of on-site disposal may be difficult.	$1,020,000
Alternative 3 Soil Capping with Asphalt (No Excavation)	Provides inadequate protection to human health and the environment. Removal action objectives are not achieved with this alternative. Because soils would not be permanently removed from the site, this alternative is highly ineffective in eliminating long term impacts to groundwater.	Technically but not administratively implementable (that is, public and regulatory agency acceptance may be difficult). Does not remove liability associated with land reuse. Restricted future land use.	$380,000
Alternative 4 Excavation and Class I and II Off-Site Disposal	Provides adequate protection to human health and the environment. Removal action objectives are achieved with this alternative. Because soils would be permanently removed from the site, this alternative is highly effective in eliminating impacts to groundwater. Off-site disposal is, however, a least preferred remedial alternative.	Implementable. Facility treatability study required to determine if pretreatment is necessary. Class I disposal facility likely to accept and dispose of waste with or without pretreatment in accordance with federal and state land LDRs. Class II disposal facility would accept waste on a case-by-case basis. Long-term liability at landfill.	$720,000 (without treatment)
Alternative 5 In-Situ Solidification or Stabilization (Fixation)	Provides moderate protection to human health and the environment. Removal action objectives are likely to be achieved with this alternative. PCBs and lead monitoring long term is required. Treated soil may affect groundwater long term.	Implementable. In-Situ immobilization would require permitting. Effectiveness of treatment requires verification by leachability study. Regulatory and community acceptance may be difficult.	$790,000
Alternative 6 No Action	Inadequate protection to human health and the environment. Removal action objectives are not attained with this alternative. Contaminants will remain on site. Natural bioremediation process results in little or no remediation over a long period of time.	Technically but not administratively implementable (that is, public and regulatory agency acceptance may be difficult). Does not remove liability associated with land reuse.	No Cost

Date: 07/10/95